Lincoln Public Schools

Secondary (6-12) Mathematics Curriculum Guide

Revised July, 2013
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Goals for Students

The Lincoln Public Schools Mathematics Program has four broad goals for students:

1. Students will acquire mathematical skills, including the ability to perform routine computations. At the secondary level, this includes traditional, but routine, symbolic manipulation.

2. Students will develop an understanding of fundamental mathematical concepts.

3. Students will become mathematical problem solvers.

4. Students will learn to value mathematics and the quantitative nature of our world.

Curriculum

Standards Instructional Objectives

The secondary math program is based on a set of specific standards and course objectives. The district math standards are the Nebraska State Math Standards and specific course objectives/syllabi have been designed to ensure students have the opportunity to acquire the knowledge and skills outlined in the Nebraska State Math Standards. The district math objectives and the syllabus for each course are available on DocuShare. The objective cards/syllabi not only outline the specific course objectives, but in addition they contain pacing information, student assessment information, Nebraska State Standards and NeSA-M correlations, and furnish useful information to students, teachers, administrators, and parents. For certain courses, the district has generated additional supplemental materials and resources. All supplemental materials and resources (course assessments) are available on DocuShare.
Middle Level Mathematics Program

Typical Middle Level Course Sequences

Option 1 (mainstream with or without math intervention):

Grade 6 → Grade 7 → Grade 8
Course Title: Math 6
Text: Holt Course 1, ©2004
Course Title: Math 7
Text: Holt Course 2, ©2004
Course Title: Math 8
Text: McDougal Littell Course 3, ©2004

Option 2: (high achiever option – student skips seventh grade math):

Grade 6 → Grade 7 → Grade 8
Course Title: Math 6
Text: Holt Course 1, ©2004
Course Title: Prealgebra
Text: McDougal Littell Course 3, ©2004
Course Title: Algebra
Text: Algebra 1, Prentice Hall © 2009

Option 3 (advanced option – not continuing diff):

Grade 6 → Grade 7 → Grade 8
Course Title: Diff Math 6
Text: Holt Course 1, ©2004
Course Title: Pre-Algebra
Text: Holt Course 2, ©2004
Course Title: Algebra
Text: Algebra 1, Prentice Hall © 2009

Option 4 (Differentiated Program):

Grade 6 → Grade 7 → Grade 8
Course Title: Diff Math 6
Text: McDougal Littell Course 2, ©2004
Course Title: Prealgebra D
Text: McDougal Littell Prealgebra, ©2005
Course Title: Algebra D
Text: Algebra 1, Prentice Hall © 2009
Middle Level Math Placement Criteria

**General Guidelines**

- Place students in the highest possible math class *subject to the criteria below*.

- **A student’s skill is the most important factor.** Work habits are not a defining consideration. This means completion of homework is not a factor unless this contributed to the lack of student understanding which would be reflected in a student’s test scores and ultimately their academic progress grade.

- No one score or criterion should be used. The single most important determinant is teacher recommendation.

**Sixth to Seventh Placement**

*Option 1: Prealgebra D (Diff course for 7th graders)*

Students placed in this course should include the following:

- **VERY Successful Math 6D students** – students earning B or above
- **BORDERLINE successful Math 6D students** – earning C/C+
  - following a discussion with 7th grade teacher and liaison
  - following a parent/contact explaining potential challenge for the student based on borderline performance

*Option 2: Prealgebra (High Achiever course for 7th grade)*

Students placed in this course should include the following:

- Students who struggled (earned below a C) in Math 6D due to a true lack of understanding. Parent contact made to explain the need for non-differentiated placement, but also the promise of algebra placement in 8th grade upon successful completion of this course.
- **BORDERLINE successful Math 6D students** – earning C/C+
  - following discussion with 7th grade teacher and liaison
  - following parent/contact to explain the decision and request approval/support (particularly if student is identified “Gifted”)
- **Highly successful Math 6 students** – earning A/B+ and “bored” or “ready” for greater challenge
  - The target student for this course is a very high achiever in sixth grade math and who has not previously been identified for the gifted program.
  - Successful performance will lead to recommendation for algebra in 8th grade

*Option 3: Math 7*

Students placed in this course are Math 6 students who do not fit under option 2.

- Students needing math intervention would be required to enroll in this regular math course.
Seventh to Eighth

Option 1: Algebra D (Diff course for 8th graders)
Students placed in this course should include the following:

- All clearly successful Prealgebra D students – Grade of B or above
- BORDERLINE & NOT Identified GIFTED Prealgebra D students – Grade of C/C+
  - following discussion with 7th grade teacher and liaison
  - following parent/contact explaining potential challenge for the student based on borderline performance
- BORDERLINE or below and GIFTED Prealgebra D students – Grade of C or below
  - following discussion with 7th grade teacher and liaison
  - following parent/contact explaining potential challenge for the student based on performance

Option 2: Algebra
Students placed in this course should include the following:

- All clearly successful Prealgebra students – Grade of B or above
- BORDERLINE successful Prealgebra students – earning C/C+
  - following a discussion with 7th grade teacher and liaison
- Students who struggled (earned below a C) in Prealgebra D due to a true lack of understanding.
  - Parent contact made to explain the need for non-differentiated placement (particularly if student has “gifted” label), but still on track to meet high school algebra graduation requirement

Option 3: Math 8 (Prealgebra Course)
Students placed in this course are 7th grade Prealgebra students who do not fit under option 2 and all Math 7 students

- Students needing math intervention would be required to enroll in this regular math course.

Mid-year Placement Adjustments

- 6th grade: When in doubt (a borderline or “on the bubble” type student) sixth grade teachers should meet with 7th grade teachers and/or the math liaison to discuss the recommendation.
  - NOTE: Extremely successful Math 6 students earning an A and “bored” or “ready” for greater challenge should be considered for placement in the Math 6D course by 2nd semester
• 7th grade: When in doubt (a borderline or “on the bubble” type student) seventh grade teachers should meet with 8th grade teachers and/or the math liaison to discuss the recommendation.
  - NOTE 1: Extremely successful Math 7 students earning an A/B+ and “bored” or “ready” for greater challenge should be considered for a move to Prealgebra by 2nd semester, in order to potentially prepare them for algebra placement in 8th grade.
  - NOTE 2: Extremely successful Prealgebra students earning an A and “bored” or “ready” for greater challenge should be considered placement in the Prealgebra D course by 2nd semester.

Middle Level Math Intervention Program

Purpose

Research indicates that middle level students who struggle in mathematics can be successful in on grade level course work provided they receive additional instructional time and support (Burris, Heubert, & Levin, 2006). To be effective, this additional instruction and support must be in addition to and integrated with the regular classroom (Balfanz, Mac Iver, & Byrnes, 2006). Therefore, the purpose of middle level math intervention is to allow all students, with the exception of functional/life skills students, access to the regular curriculum with the support they need to be successful. Math Intervention (in its traditional configuration) is an extension of the regular grade level course that provides students who need it additional focused instruction and support.

Placement

Specific grade level considerations are listed below. However, there are three important considerations when recommending students for middle level math intervention. First, placement is based on multiple factors. That is, no student should be placed in math intervention solely based on test scores. Second, placement is based on teacher recommendation with consideration of multiple factors. Third, because Math Intervention is an extension of the regular course, no student should be placed in math intervention if she/he is not also enrolled in the corresponding grade level math course. That is, no student should be enrolled in math intervention as his/her sole math course.

Parents may waive enrollment of their student in Math Intervention. Use of the waiver should not be encouraged. However, if a parent indicates she/he does not want the student enrolled in the support course, the district cannot force the student to participate. Before offering the waiver it is important to engage the parent in one or more personal conversations during which an attempt is made to explain the benefits of the program and potential consequences of not participating. A letter and waiver form are found in this guide. A copy of the signed waiver should be kept in the student’s cumulative file. The building principal is responsible for obtaining the parents’ signature on the waiver.
Grade 6 Placement Considerations

Placement is based on teacher recommendation. Fifth grade teachers should consider the following student characteristics when making recommendations for sixth grade math intervention:

- Fifth grade students who required significant re-teaching to reach proficiency on fifth grade objectives.
- Fifth grade students who mastered less than 60% of the objectives.
- Teachers should also consider the nature of the objectives not mastered. Were there significant gaps, i.e. entire chapters/topics missed? Did the student struggle more with later content and/or difficult topics?

Other considerations:

- All incoming sixth grade students could be placed in regular sixth grade courses and after the first 2-3 weeks of school sixth grade teachers can recommend students for intervention.
- Placement recommendations should be reviewed in the summer after additional assessment information is received.

Grade 7 & 8 Placement Considerations

Placement is based on teacher recommendation. Current math teachers, in consultation with receiving math teachers, should consider the following student characteristics when making recommendations for grade 7 or 8 math intervention:

- Students who required significant re-teaching to reach proficiency on grade level objectives.
- Teachers should also consider the nature of the objectives not mastered. Were there significant gaps, i.e. entire chapters/topics missed? Did the student struggle more with later content and/or difficult topics?

Structure of Middle Level Math Intervention

The Middle Level Math Intervention Program provides an additional period of direct instruction. In grades 6 and 7 the intervention takes place every other day and is paired with physical education. In grade eight the intervention takes place every day. For maximum effectiveness co-teachers should be assigned to Math Intervention whenever possible and course size should be 20 or less.

Middle Level Math Intervention Goals

- To increase student self-efficacy in mathematics.
- To support students in mastering grade level math standards.
- To re-teach critical concepts and skills based on DCA results to prepare for NeSA-M.
- To fill pre-requisite grade level skill gaps.
Components of Math Interventions Lessons

Math Intervention lessons should be designed so that students have the opportunity to “experience” mathematics through a variety of learning tasks. Learning tasks need to vary so that students do not become bored. Although the goal of Intervention is not necessarily to make math “fun,” (the research indicates students “enjoy” those subjects in which they experience success and this is the ultimate goal of Intervention) by varying the learning tasks and making the instruction engaging the Intervention teacher has the opportunity to reach more students and build success. Components of this experience may include:

- Direct instruction – **Math Intervention is not a homework/study hall period.**
- Re-teaching of regular course content with emphasis on results of District Common Assessments for Math (DCA-M = Benchmark).
- Spiral review (emphasis on DCA review materials)
- Additional guided practice.
- Pre-teaching of concepts in the regular course.
- Re-teaching pre-requisite skill gaps based on regular course pacing – an effective and quick warm-up activity.
- Classroom discussion and “math talk” – there should be a great deal of teacher-student interaction during class.
- Re-teaching of regular course objectives.
- Hands-on learning tasks with extensive modeling.
- An emphasis on teaching math vocabulary – word walls.
- Use of the regular course Notetaking Guides.
- Guided feedback on regular course homework.
- An emphasis on reading, understanding, and representing problems – the problem solving process.
- Technology, including use of the publishers’ websites for re-teaching, and practice.

Grouping Decisions

For maximum effectiveness Math Intervention should be taught by the same teacher who provides the student’s regular instruction. Specifically, the regular course and the Intervention are linked together in a “block” of instruction that provides students continuity of instruction, maximizes instructional time, and minimizes teacher-to-teacher communication issues. For example, if a regular math course has 25 students in it, 12 students may be in Intervention and 13 may be mainstream students. Having a mixture of students in the regular course is a high priority. Having an entire course that also constitutes an entire Intervention course is to be avoided – such a structure sets low expectations for students and teachers, slows the pace, and denies students an opportunity to learn grade level objectives.

When the Intervention teacher is not the student’s regular classroom teacher then “real-time” communication between the Intervention teacher and regular teacher is an absolute must to
ensure the effectiveness of Math Intervention. Without continual communication it is impossible for the Intervention teacher to know what to work on with students during Intervention. The following are suggestions for improving teacher-to-teacher communication and collaboration:

- All teachers of regular courses need to stay on pace.
- Communication is more likely to occur when teachers of the same grade level share a common plan period.
- The Math and Intervention teacher need to routinely (at least weekly) share grade reports, including a list of missing work, non-mastered objectives, re-teaching needs, and objectives with which the student struggles.
- In eighth grade where the Intervention teacher meets with students daily, the Intervention teacher should assume responsibility for initiating communication with the math teacher.
- If necessary, an occasional class-cover could provide the math and Intervention teacher an opportunity to “catch-up” and discuss student needs.

**Exiting Math Intervention**

Math Intervention should not be viewed as a permanent assignment. Ideally, Math Intervention placement should be fluid with students entering and exiting as need dictates. In order to meet the needs of building schedules, it may be necessary for students to exit at natural breaks, e.g. at the end of a quarter.

Students may leave intervention when recommended by the Math Intervention and/or regular classroom teacher. Students who do not want to leave Intervention and who are making effective use of their time should not be forced to exit Intervention. When making this recommendation the teacher(s) should consider whether or not the student can maintain a grade of “B” in the regular course without intervention support and if the student demonstrates an ability to retain learned material. Before a student exits Math Intervention his/her parents should be consulted.

If a student leaves Intervention and later slips in the regular course, e.g. fails to maintain a grade of “B”, the student should re-enter Math Intervention.
Progress/Final academic mark for Math Intervention

Because Math Intervention is an extension of the regular math course and is intended to support student mastery of the regular objectives. Math Intervention is to be graded on an **individual basis** and is given either **satisfactory (S)** or **needs improvement (N)** under the progress/final grade column. Commendable (C) is not an option as this sometimes sends parents a false message concerning the student’s academic achievement in mathematics. Generally, students of this nature do not need to be in Math Intervention.

**S**  The *Satisfactory* student consistently uses his/her time in Math Intervention to improve his/her understanding of grade level objectives and this is **reflected in the student’s regular course success**. This implies that communication has taken place between classroom and Intervention teacher if they are not the same person.

**N**  The *Needs Improvement* student does not consistently use his/her time in Math Intervention to improve his/her understanding of grade level objectives and this is **reflected in the student’s regular course success**. This implies that communication has taken place between classroom and Intervention teacher if they are not the same person.

**Sample MIDDLE SCHOOL REPORT CARD**

March 19, 2007
To the Parents/Guardian of:
PATTY HAMMOND
6720 S 43RD ST
LINCOLN NE 68516

Student Name:  PATTY HAMMOND
School:      SCOTT
Counselor:   N TEGLER
Grade:          08
Year:             2006 - 07 SEM 1

<table>
<thead>
<tr>
<th>Course</th>
<th>Instructor</th>
<th>Progress Grades</th>
<th>Final Grades</th>
<th>Basis</th>
<th>Work Study Habits</th>
<th>Social Behavior Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math Intervention</td>
<td>M. Larson</td>
<td>Mark should be</td>
<td>IND</td>
<td>C, S, N Use the district descriptors.</td>
<td>C, S, N Use the district descriptors.</td>
<td></td>
</tr>
<tr>
<td>Participates constructively in class</td>
<td></td>
<td>S or N Use descriptors below. NO ACADEMIC GRADE SHOULD EVER BE GIVEN HERE.</td>
<td></td>
<td></td>
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Total Absences:  2.25  Total Tardies:  1

**Meaning of Marks**

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<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>Superior</td>
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<tr>
<td>B+</td>
<td>C+</td>
</tr>
<tr>
<td>B</td>
<td>D+</td>
</tr>
<tr>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>D</td>
<td>Failing</td>
</tr>
<tr>
<td>W</td>
<td>Withdrew</td>
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</table>

**Work Study Habits**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>IND</td>
<td>Individual</td>
</tr>
</tbody>
</table>

**Social Behavioral Skills**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM</td>
<td>Commendable</td>
</tr>
<tr>
<td>U</td>
<td>Unsatisfactory</td>
</tr>
<tr>
<td>N</td>
<td>Needs Improvement</td>
</tr>
</tbody>
</table>

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Sample Math Intervention Parent Letter

Date, 20XX

Dear Parent/Guardian:

At _________ Middle School our primary concern is for your student’s academic success. We want to do all we can to support students as they progress through middle school and help ensure that students will be able to meet high school graduation requirements. In order to support students, we offer interventions in reading and math for students who may benefit academically from them.

Based on your student’s previous math placement, success in his/her current math course, and standardized-test scores, staff members are recommending that your student be enrolled in mathematics intervention next year in addition to his/her regular math placement.

The purpose of math intervention is to provide your student with additional direct math instructional time and to address previous skills that were not mastered in order to help keep him/her on grade level. Our goal is to address your student’s specific needs and move him/her out of intervention as soon as it is academically appropriate to do so. Longitudinal data on high school students’ success indicate that students who are enrolled in the appropriate mathematics courses greatly enhance their probability of meeting the graduation requirement in a timely manner.

Our professional recommendation to place your student in math intervention is made with your student’s current and long term academic interests in mind. If you do not want your student enrolled in math intervention, we ask that you complete the attached waiver.

Sincerely,

Principal
_______ Middle School
Math Intervention Waiver Form

My signature below acknowledges that I DO NOT wish to have my student enrolled in mathematics intervention and understand the following:

1. Staff at ________ recommends that in order to maximize my student’s probability of success in mathematics in middle school and in high school that he/she be enrolled in mathematics intervention.

2. I will not hold the Lincoln Public School District liable for my student’s need for additional mathematics instruction during high school, nor for any additional time my student may require to complete his/her high school graduation requirements.

Signed: ____________________________________________ Date: ________  
(Parent/Guardian signature)

Signed: ____________________________________________ Date: ________  
(Parent/Guardian signature)

Signed: ____________________________________________ Date: ________  
(Middle School Principal, Lincoln Public Schools)

Note: Waiver must be completed annually.

Copies: Parent  
Student’s Cumulative File
**Middle Level Course Descriptions**

**Math 6**

This first secondary mathematics course introduces students to the core mathematics strands: computation, measurement, geometry, algebra, data analysis, and probability. One of the major themes of this course is problem solving with decimals and fractions.


**Math 6D**

This first secondary mathematics course introduces students to the core mathematics strands: computation, measurement, geometry, algebra, data analysis, and probability. The differentiated course covers additional topics in greater depth than Math 6.

Text: McDougal Littell Course 2, ©2004

**Math 7**

In this second course students continue their study of the core mathematics strands. The major emphasis of this course is on proportional reasoning, integers, geometry, and algebra readiness.


**Prealgebra**

*Prealgebra* is an accelerated course for seventh grade students. Students in this course skip traditional seventh grade math and instead focus on preparation for algebra in grade 8.


**Prealgebra D**

*Prealgebra D* is an accelerated and differentiated course. Students in this course skip traditional seventh grade math and instead focus on a rigorous preparation for algebra in grade 8.

Algebra and Algebra D*

Algebra is the first course in the traditional college preparatory sequence. Course topics include equation solving, linear sentences, linear inequalities, lines, slope, graphing, exponents and powers, polynomials, systems of equations, quadratic equations, functions, and statistics. This course is available in middle school in both a regular and differentiated version.


*It is critical to note that algebra in grade 8 counts towards high school graduation requirements. Specifically, students earn high school credit for the course and a student’s grade in the course is a factor in a student’s high school GPA and class rank.
High School Mathematics Program

Graduation Requirement

The high school graduation requirement is 30 hours of mathematics, including course work in algebra and geometry. The 30 hours of mathematics credit must come from courses beginning with Algebra/Algebra Block (special education students will graduate according to requirements outlined in their IEP). This does not mean that a student has to pass each semester of algebra and geometry to graduate, only that a student’s 30 hours of mathematics must include, at a minimum, 5 hours of algebra credit and 5 hours of geometry credit.

Typical High School Course Sequences*

<table>
<thead>
<tr>
<th>Grade 9</th>
<th>Grade 10</th>
<th>Grade 11</th>
<th>Grade 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Title:</td>
<td>Course Title:</td>
<td>Course Title:</td>
<td>Course Title:</td>
</tr>
<tr>
<td>Algebra Block</td>
<td>Geometry Plus 1</td>
<td>Geometry Plus 2/Elements of Advanced Alg</td>
<td>Advanced Algebra</td>
</tr>
</tbody>
</table>

| Option 2: | | | |
| Course Title: | Course Title: | Course Title: | Course Title: |
| Algebra | Geometry | Advanced Algebra | Precalculus |

| Option 3: | | | |
| Course Title: | Course Title: | Course Title: | Course Title: |
| Geometry | Advanced Algebra | Precalculus | AP Calculus |

| Option 4: | | | |
| Course Title: | Course Title: | Course Title: | Course Title: |
| Geometry D | Advanced Algebra D | Precalculus D | AP Calculus D |

Recommendation: Completed Algebra D with C+ or better &/or teacher recommendation

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Note: When in doubt concerning two different placements, the student should always be placed in the more rigorous course.

*These represent “typical” sequences of district-wide supported courses. Individual high schools may offer unique courses. All placements should be based on individual student interest and need.

High School Course Descriptions

Algebra and Algebra Block

Algebra is the first course in the traditional college preparatory sequence. Course topics include equation solving, linear sentences, linear inequalities, lines, slope, graphing, exponents and powers, polynomials, systems of equations, quadratic equations, functions, and statistics. Algebra Block is a double period course for students who require additional time to master the objectives.

Text: *Algebra 1, Prentice Hall © 2009.*

Geometry Plus, Geometry, and Geometry D

This is a traditional plane geometry course. Topics include reasoning and proof, lines, triangles, quadrilaterals, transformations, similarity, right triangles, circles, area and volume. The differentiated course studies additional topics in greater depth than the regular course. The differentiated course is open only to students who completed differentiated algebra with a recommended grade of C+ or better. The differentiated course is open to other students with permission of the math department chair or designee. Geometry is a one-year course and Geometry Plus is a three semester course for students who require additional time to master the objectives. In addition, Geometry Plus also focuses on NeSA-M preparation.

Text Geometry & Geometry Plus: *Geometry, ©2012 Holt McDougal*

Elements of Advanced Algebra

Elements of Advanced Algebra is a one semester course that follows the third semester of geometry plus and is only open to students who were enrolled in geometry plus. Course content includes an introduction to advanced algebra concepts in addition to preparation for the NeSA-M. The course uses district created materials.

Advanced Algebra and Advanced Algebra D

Practical applications are the basis for the study of linear equations, inequalities, and functions, systems of equations and inequalities, matrices, quadratic functions, polynomial functions, powers, roots and radicals, exponential and logarithmic functions, rational equations, quadratic
relations, sequences and series, and probability. The differentiated course studies additional topics in greater depth than the regular course. The differentiated course is recommended for students who completed differentiated geometry with a grade of C+ or better. The differentiated course is open to other students with permission of the math department chair or designee. The differentiated course qualifies for a weighted grade.


Precalculus is designed for students intending to continue their study of mathematics in the traditional calculus sequence. This course includes a thorough study of trigonometric functions and their properties, limits of functions and sequences, properties of algebraic, exponential and logarithmic functions, and polar coordinates. The differentiated course is open only to students who completed differentiated advanced algebra with a grade of C+ or better. The differentiated course is open to other students with permission of the math department chair or designee. The differentiated course qualifies for a weighted grade.

Text Precalculus/ Precalculus D; *Algebra and Trigonometry Eighth Edition, Pearson Prentice Hall © 2008*

*AP Calculus and AP Calculus D*

Calculus is a college-level course covering topics that are normally studied during the first two semesters of calculus in college. Topics include limits, continuity, derivatives, the definite integral, trigonometric and exponential functions, vectors, methods of integration, and applications of the derivative and integral. The differentiated course completes the first two semesters of college calculus; the regular course completes the first semester and part of the second semester. Students who complete the differentiated course may enroll in the third semester at UNL. Students who complete the regular course may enroll in the second semester course at UNL. Students may qualify for university credit. The differentiated course is open only to students who completed differentiated precalculus with a grade of C+ or better. The differentiated course is open to other students with permission of the math department chair or designee. Both courses qualify for a weighted grade.

Text: *Calculus, University, Wiley © 2011*

*AP Statistics*

AP Statistics is a year-long course emphasizing distributions, data displays, probability, and inferential statistics for decision-making. The prerequisite course is advanced algebra. AP Statistics may also be taken along with Precalculus or Calculus.

Text: *STATS: Modeling the World. ©2010, Addison Wesley*
### High School Math Failure Recommendations* – Semester 1

<table>
<thead>
<tr>
<th>Course Failed</th>
<th>Second Semester Course Options</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra Block Semester 1</td>
<td>Off semester Algebra with an algebra support class</td>
<td>Appropriate for students who were close to passing, but need to shore up certain skills.</td>
</tr>
<tr>
<td></td>
<td>Off semester algebra block.</td>
<td>Appropriate for the majority of failures.</td>
</tr>
<tr>
<td></td>
<td>Continue in second semester algebra block.</td>
<td>Appropriate for students who understand the content but failed for non-academic reasons. Passing second semester can replace first semester failure with “S.”</td>
</tr>
<tr>
<td></td>
<td>Sit out math second semester and re-enroll next year.</td>
<td>Appropriate for students with severe behavior/non-attendance issues.</td>
</tr>
<tr>
<td>Algebra Semester 1</td>
<td>Off Semester Algebra</td>
<td>Appropriate for students who lack skills.</td>
</tr>
<tr>
<td></td>
<td>Continue in course</td>
<td>Appropriate for students who understand the content but failed for non-academic reasons. Passing second semester can replace first semester failure with “S.”</td>
</tr>
<tr>
<td></td>
<td>Algebra Block Semester 2</td>
<td>Appropriate for students with a weak understanding of the content, but who failed primarily for non-academic reasons. Passing second semester can replace first semester failure with “S.”</td>
</tr>
<tr>
<td>Geometry Plus 1 Semester 1</td>
<td>Continue in course</td>
<td>Only option. Feasible because the semesters are largely independent of each other.</td>
</tr>
<tr>
<td>Geometry Semester 1</td>
<td>Off Semester Geometry.</td>
<td>Appropriate for majority of failures.</td>
</tr>
<tr>
<td></td>
<td>Geometry Plus 1 Semester 2</td>
<td>Appropriate for students who need more support and processing time to be successful.</td>
</tr>
<tr>
<td></td>
<td>Off Semester Advanced Algebra (if available)</td>
<td>Appropriate for majority of failures.</td>
</tr>
<tr>
<td></td>
<td>Non-AP Stat Course</td>
<td>Appropriate for seniors.</td>
</tr>
<tr>
<td>PreCalculus Semester 1</td>
<td>Precalculus Semester 2</td>
<td>Appropriate for all students.</td>
</tr>
</tbody>
</table>
# High School Math Failure Recommendations – Semester 2

<table>
<thead>
<tr>
<th>Course Failed</th>
<th>Fall Semester Course Options</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra Block Semester 2</td>
<td>Off semester Algebra with an algebra support class</td>
<td>Appropriate for students who were close to passing, but need to shore up certain skills.</td>
</tr>
<tr>
<td></td>
<td>Off semester algebra block.</td>
<td>Appropriate for the majority of failures.</td>
</tr>
<tr>
<td></td>
<td>Continue to Geometry Plus.</td>
<td>Appropriate for students who have 10 hours of math credit from Algebra Block Semester 1.</td>
</tr>
<tr>
<td>Algebra Semester 2</td>
<td>Off Semester 2 Algebra</td>
<td>Appropriate for students who lack skills.</td>
</tr>
<tr>
<td>Geometry Plus 1 Semester 2</td>
<td>Continue in course.</td>
<td>Appropriate for students who have 20 hours of credit from Algebra block and credit in Geometry Plus Semester 1.</td>
</tr>
<tr>
<td></td>
<td>Repeat in fall if the student also failed Geometry Plus Semester 1</td>
<td>Appropriate for students who did not enter Geometry Plus with 20 hours of credit from Algebra Block.</td>
</tr>
<tr>
<td>Geometry Plus 2 Semester 2</td>
<td></td>
<td>Placement dependent on whether credits are needed for graduation.</td>
</tr>
<tr>
<td></td>
<td>Geometry Plus 2 Semester 1</td>
<td>Appropriate for students who need more support and processing time to be successful.</td>
</tr>
<tr>
<td>Advanced Algebra Semester 2</td>
<td>Off Semester Advanced Algebra (if available)</td>
<td>Appropriate for majority of failures.</td>
</tr>
<tr>
<td></td>
<td>Start Advanced Algebra over again in fall.</td>
<td>Appropriate for juniors who failed due to a lack of skill.</td>
</tr>
</tbody>
</table>

*These are general recommendations. Each student is unique and must be treated accordingly. Carefully examining a student’s current math credits, prior course work, individual needs, and post-secondary plans, all play a role in individual recommendations. Exceptions can and should be made as appropriate for individual students.*
Assessment and Reteaching (Middle Level and High School)

Re-teaching and re-learning is a research-based instructional strategy to improve student learning. The National Mathematics Advisory Panel recommended the use of assessments for the purpose of modifying instruction based on student progress (NMAP, 2008). Research indicates that when the results of assessment are used to provide students additional instruction, practice, and reinforcement in the skills and/or concepts with which they struggle, that student achievement is improved (Baker, Gersten, & Lee, 2002). Research also indicates that when students who struggle to learn mathematics are allowed enough time to master content, they can perform at levels approaching high achieving students (Usiskin, 2007). The research clearly supports the use of additional instructional time as a strategy to improve student achievement (Balfanz, Mac Iver, & Byrnes, 2006; Burris, Heubert, & Levin, 2006; Cawelti & Protheroe, 2001). Marzano (2010) has found that re-teaching and re-assessment can result in a twenty-percentile improvement in student achievement. Therefore, re-teaching and re-assessment is now a required district expectation in mathematics from Kindergarten through Differentiated Precalculus. In order to prepare students for possible course work beyond high school, there is a steady decline in the amount of re-assessment that takes place as students progress through the curriculum as outlined below:

- Algebra: Retesting occurs on both chapter tests and cumulative assessments. Retesting is used for grade replacement.
- Geometry: Retesting occurs only on cumulative assessments. Retesting is used for grade replacement.
- Advanced Algebra: Retesting occurs only on cumulative assessments.
- PreCalculus: Retesting occurs only on first and third quarter cumulative assessments.
- Calculus: No retesting.

Format of District Assessments

The NeSA-M emphasizes the application of mathematics. Specifically, many of the assessment items on the NeSA-M require students to draw on a variety of mathematical topics and apply these topics to novel problems that students may have never previously seen. This places an emphasis on student mathematical understanding, as opposed to rote procedural skill, so that students can make appropriate connections among mathematical topics and draw on their understanding to solve problems. Therefore, all secondary math objectives and assessments through precalculus are organized around connected “Big Ideas.” It is a district expectation that district chapter (Big Ideas), cumulative assessments, and finals will be used to ensure consistency and that they will not be modified (beyond special education requirements) to adjust the cognitive demand.

The purpose of Big Ideas is to emphasize mathematical connections and understanding, not discrete and disjoint topics. For example, previously in algebra there were separate objectives on solving systems of linear equations by graphing, using substitution, and using elimination. These objectives would have typically been taught as discrete topics, as opposed to three equally valid strategies to solve a system of linear equations. The topics would then have been assessed
separately, and the individual topics would have been re-taught and re-assessed separately if necessary. Now, the Big Idea is solving a system of linear equations. Instructionally, the emphasis is on solving a system, students learn three different, but equally valid strategies to do this, and when assessed, students are simply presented with a system to solve. The choice of strategy is up to the individual student. It is not necessary to assess all three strategies individually.

In order to address teacher workload concerns, math assessments have embedded the re-assessment concept within chapter assessments and periodic cumulative re-assessments. The use of these district assessments and embedded re-assessments removes the need for teachers to create re-assessments of their own and ensures that all students have an opportunity to be re-assessed. Embedding the re-assessment in formal subsequent assessments also lessens the tendency of some students to “game the system” and simply wait until after an initial assessment has been administered to determine what will be assessed and then study those specific items for the re-assessment.

**Re-assessment Procedures**

Re-teaching (not just additional practice) and re-learning must take place prior to re-assessment for the strategy to be effective at improving student learning. It is assumed that all teachers will provide all students an opportunity to continue to master topics they have not yet mastered through appropriate re-teaching either inside or outside of the regular instructional time. Because re-assessment is embedded within formal and required district assessments, all students will have access to re-assessment opportunities regardless of their compliance with behavioral expectations, e.g. homework completion.

**Re-assessment on Chapter Assessments**

- Chapter tests which do not begin a semester or follow a cumulative assessment will include a re-assessment of one big idea from the previous chapter. This is determined in part by what is assessed by NeSA-M and in part based on what is most essential for students to know moving forward in the curriculum.
- Assessment sections from chapter tests will be entered in Pinnacle as individual scores.
- The length of the re-assessment section may not match the original assessment.
- A score is replaced only if the student improves because re-assessment is more likely to prove a positive than a negative.
- Although the opportunity to re-learn should be a significant motivator, the reality is that for many students the opportunity to replace a low score serves as a motivation to engage in the re-learning process.
- Because retention and understanding are essential goals, the re-assessment section of a chapter test is used not only for the purpose of re-assessment and grade replacement, but also constitutes a new score in a student’s grade.
Cumulative Assessments

- Cumulative assessments are used as a way to emphasize the importance of retention as well as an additional vehicle for students to demonstrate re-learning.
- Cumulative assessments are administered periodically following 2-3 chapters of instruction with the exception of Geometry Plus.
- Cumulative assessments will assess all big ideas from the previous chapters (since the time of the last cumulative assessment).
- In algebra and above, the last chapter of each semester will not be included on a cumulative assessment. This provides teachers with additional time to process cumulative exams and create instructional space prior to the final exam.
- Cumulative assessments focus on assessment of students’ retention of critical concepts. The rigor of a cumulative assessment resides in the retention. It is not possible to re-assess every concept as it was assessed on the original assessment, or necessarily at its original depth.
- The cumulative assessment also counts as a single new score in a student’s grade. This serves to motivate students to retain previous learning.

Final Exam

- The final exam serves to assess student learning across a semester’s big ideas, but can only survey essential topics – it cannot re-assess every big idea at the level done on individual chapter tests.
- Although the final exam is not used to replace previous individual assessment scores, a teacher can consider a student’s performance on the final for a student’s final grade (if that does not lower a student’s final grade).
- The goal is for the final exam to account for approximately 10% of a student’s grade.

District Common Assessments

- District Common Assessments (DCAs) are a critical component of the district’s NeSA-M preparation program. DCAs must be administered in designated courses at designated times. Results must be used to plan intentional review and re-teaching of critical NeSA objectives.

Additional Assessment Guidelines

- All summative tests in classes other than Algebra Block are to be completed in one 50-minute period. The reassessment portion of an assessment may be given on a separate day, but should be limited in time (approximately 20 minutes). When given on a separate day, no review should be done prior to the reassessment. Algebra Block classes may continue summative assessments into a second period on the same day as needed.
- Teachers should use their professional judgment concerning providing individual students additional time to complete assessments. For example, if a student works diligently to complete an assessment, but needs some additional time to complete it, the teacher can and should allow the student to come in before or after school to complete it.
• Geometry Plus will give a summative exam following each Big Idea in a unit. Exams will include the same content as Geometry and have additional questions to reinforce the algebra concepts included in geometry. The cumulative exam will cover two Big Ideas and is to be given after reteaching of both Big Ideas in the unit. Each exam should be completed in one 50 minute period. The NeSA-M Reference Sheet may be used on all assessments in Geometry Plus.

• The NeSA-M Reference Sheet may be used on cumulative and final assessments in middle level courses, Algebra, Geometry, and Advanced Algebra courses (regular and diff).

• The content of summative assessments must remain consistent throughout the district. Only changes in layout of the assessment are permissible.

• Summative assessments are not to be given by separating Big Idea sections into separate portions unless the student is permitted additional time.

• Cumulative assessments serve two purposes: to measure retention and to serve as a reassessment following re-teaching (grade replacement). Therefore it is critical that students have the opportunity to re-learn concepts they did not master on previous Big Idea tests prior to administering the cumulative assessment. Shutting down new instruction to spend multiple days reviewing for a cumulative assessment is not appropriate; rather, retention can and should be promoted through intentionally designed and teacher provided warm-up activities that review critical concepts while continuing new content.

• All summative assessments, with the exception of the final exam, also serve a formative function in the sense that teachers should use the results to design and provide students with appropriate re-teaching prior to the next summative test or cumulative assessment.

• In either a makeup situation or a situation where a student is allowed additional time, it is never appropriate for a student to return and complete a page which has previously been viewed.

Pinnacle

• Point values for Big Ideas, Cumulative Assessments, and Finals, are found on DocuShare and must be followed for student grading to be consistent and equitable across the district.

• At the middle level the Pinnacle grading template is 100% summative and 0% formative.

• At the high school level the Pinnacle grading template is 90% summative and 10% formative (this includes algebra in grade 8).
Essential Components of Effective Math Lessons

Effective mathematics instruction is student centered, but teacher directed (Muijs & Reynolds, 2000; Whitehurst, 2003). The district supports the balanced use of purposeful teacher selected learning tasks and the use of math talk to develop conceptual understanding, combined with extensive guided practice and appropriate independent practice to help ensure mastery, fluency, and retention.

Research on effective teaching has not suggested a direct association between a single method of teaching and a resulting goal. Research points to certain features of instruction that result in improved student learning (Hiebert & Grouws, 2006). Features of effective instruction can be grouped into five major components that appear in all lessons (Dixon et al., 1998; Muijs & Reynolds, 2000; Weiss, Heck, Shimkus, 2004; Whitehurst, 2003). High quality instruction is marked by an ebb and flow of direct instruction, modeling, and practice. Teachers may move between these components fluidly throughout each math lesson:

- Introduction
- Lesson Development
- Guided Practice
- Closure
- Independent Practice

It is important to understand that these components of effective instruction do not necessarily have to be done in lock step order (although obviously the introduction marks the start of a mathematics lesson). The graphic below illustrates that these components interact in different ways as different lessons unfold. The sizes of the circles that represent the five major components reflect the relative time spent on each component in a typical math lesson, e.g. lesson development and guided practice consume the bulk of a typical math lesson.
The Introduction

All instructional decisions need to start with a review of the math objectives (see DocuShare for course syllabi and objectives). Effective teachers begin their planning with a mathematics objective in mind; less effective teachers begin their planning with an activity objective in mind. This difference may seem minor, but the research indicates it has a significant impact on student learning. Weiss, Heck, and Shimkus (2004) have found that high quality math lessons were always focused on the specific math objective, concept or skill, to be learned.

It is not enough for the teacher to have this objective in his/her mind. Research indicates that students learn more when teachers share the objective with students (Muijs & Reynolds, 2000). Sharing the objective is associated with higher levels of achievement and is one way to help students identify the key point of a lesson and focus on what is important (NCES, 2003).

In addition to the focus on the lesson objective, the introduction also emphasizes the connection to prior learning and a quick review. Opening the lesson with a well-chosen problem of the day is an effective way to begin class. Appropriate problem(s) of the day can be based on an analysis...
of the previous day’s homework, cumulative review based on Big Idea assessments, and/or NeSA-M review problems based on DCA analysis.

**Lesson Development**

Students have to do more than simply explore tasks and problems. Teachers must help students process tasks and problems in a meaningful way. Students do not learn solely by doing things; rather, they learn by thinking, discussing, and reflecting on what they have done.

**Mathematical Tasks**

Once the objective has been selected, the teacher designs learning tasks to promote student engagement with and learning of the objective. It is important to keep in mind that the overall goal of each lesson, no matter what the topic is, must be to help students make sense of the mathematics (Weiss, Heck, Shimkus, 2004).

A well designed task engages students with the mathematics concepts by having students interact purposefully with the content (Weiss, Heck, Shimkus, 2004). Worthwhile mathematical tasks are “ones that do not separate mathematical thinking from mathematical concepts or skills, that capture students’ curiosity, and that invite them to speculate and to pursue their hunches” (NCTM, 1991, p. 25). Other researchers have argued that in order for students to build mathematical understandings, the tasks with which they engage “must allow the students to treat the situations as problematic, as something they need to think about rather than as a prescription they need to follow” (Hiebert et al., 1997, p. 18). Effective tasks also demand more from students, i.e. they are cognitively demanding. High cognitive demand tasks provide students opportunities to explain, describe, justify, compare, or assess; to make decisions and choices; to plan and formulate questions; to exhibit creativity; and to work with more than one representation in a meaningful way (Silver, 2010).

When students are engaged in a worthwhile mathematical task they often initially experience discomfort. In order to deal with this discomfort, students often urge teachers to make these types of tasks more explicit by breaking them down into smaller steps, specifying exact procedures to be followed, or actually doing parts of the task for students. Should the teacher succumb to such requests, the challenging, sense-making aspects of the task are reduced or eliminated, thereby robbing students of the opportunity to develop thinking and reasoning skills and meaningful mathematical understandings (Stein, Remillard, & Smith, 2007).

Students need to be given the opportunity to engage in a certain amount of productive struggle (Hiebert & Grouws, 2007). Productive struggle does not mean needless frustration or extreme levels of challenge created by overly difficult problems. It means that students expend effort to make sense of mathematics, to figure something out that is not immediately apparent. Simply put, it means the opposite of being presented information to be memorized or being asked only to practice what has been demonstrated by the teacher. It is important not to misinterpret this recommendation: it does not mean that teachers should never tell students anything. Telling is often necessary and appropriate. Appropriate telling can include sharing mathematical conventions, suggesting alternative solution methods, introducing more clear or efficient recording techniques, and articulating ideas in students’ solution methods. “Telling is legitimate
if it does not take fundamental agency for making sense away from students” (Hiebert et al., 1997).

Questioning

One way for teachers to scaffold or support students’ continued engagement with a task and to tell without taking the fundamental agency for sense making away from students is to focus on asking very good questions. Asking questions that scaffold or support students’ continued engagement with a task and that press students to explain and justify their thinking are key to sustaining the cognitive demands of mathematical tasks (Stein, Remillard, & Smith, 2007). Highly effective teachers can actually use a series of questions in such a way that the questions actually tell (Lobato, Clarke, & Ellis, 2005).

Discussion (math talk) is a hallmark of classrooms in which students build mathematical understandings (Hiebert et al., 1997). Cross-national research studies indicate that effective teachers focus on having a discussion aimed at exploring the underlying concepts and that they set this direction by carefully asking questions (Ma, 1999). Research indicates that highly effective teachers ask many questions during instruction:

- they ask questions to involve students in class discussion;
- they ask questions of many types during lessons;
- they pose more higher-level questions with greater cognitive demand;
- they ask more follow-up questions;
- they ask questions so that all students have to think of a response and provide wait time;
- they rephrase student questions and provide prompts when pupils are unable to initially respond;
- they re-direct student questions to the class before responding to them personally (Muijs & Reynolds, 2000; McRel, 2010).

Effective teachers ask questions not just to find out what students know, but to provoke deeper thinking aimed at helping students make sense out of the mathematics (Weiss, Heck, & Shimkus, 2004). Effective teachers not only ask cognitively demanding questions, but they also listen to student responses in specific ways. Effective teachers don’t listen for particular responses; rather, they listen to monitor emerging student understandings – to make sense of the sense students are making (Davis, 1997) and use that information to guide instruction. If teachers listen for student understandings rather than specific answers, then questions offer teachers windows into students’ thinking and thus provide information about how better to help students along a learning path (NRC, 2005).

A set of generic question prompts is included below (source: pbs.org/teacherline):

**To help students when they get stuck, ask …**

- How would you describe the problem in your own words?
- What do you know that is not stated in the problem?
- What facts do you have?
- How did you tackle similar problems?
- Could you try it with simpler numbers? Fewer numbers?
Would it help to create a diagram? Make a table? Draw a picture?
Can you estimate and verify?
Have you compared your work with anyone else?

To make connections among ideas and applications, ask …
How does this relate to …?
What ideas that we have learned before were useful in solving this problem?
Can you give me an example of …?

To encourage reflection, ask …
How did you get your answer?
Does your answer seem reasonable? Why or why not?
Can you describe your method to all of us? Can you explain why it works?
What if you had started with … rather than …?
What if you could only use …?
What have you learned or found out today?
Did you learn any new words today? What do they mean?
What are the key points or big ideas in this lesson?

To promote problem solving, ask …
What do you need to find out?
What information do you have?
What strategies are you going to use?
Will you do it mentally? With paper and pencil?
What do you think the answer or result will be?

To help students build confidence and rely on their own understanding, ask …
Why is that true?
How did you reach that conclusion?
Does that make sense?
Can you make a model to show that?

To help students learn to reason mathematically, ask …
Is that true for all cases? Explain.
Can you think of a counterexample?
How would you prove that?
What assumptions are you making?

To check student progress, ask …
Can you explain what you have done so far? What else is there to do?
Why did you decide to use this method?
Can you think of another method that might have worked?
Is there a more efficient strategy?
What do you notice when …?
Why did you decide to organize your results like that?
Do you think this would work with other numbers?
Have you thought of all the possibilities? How can you be sure?
To help students collectively make sense of mathematics, ask …

What do you think about what _____ said?
Do you agree? Why or why not?
Does anyone have the same answer but a different way to explain it?
Do you understand what _____ is saying?
Can you convince the rest of us that your answer makes sense?

To encourage conjecturing, ask …

What would happen if …? What if not?
Do you see a pattern? Can you explain the pattern?
What are some possibilities here?
Can you predict the next one? What about the last one?
What decision do you think he/she should make?

Using Mathematical Representations Effectively

Discussion generated by effective questions is one way teachers can address the overarching goal of helping students make sense of the mathematics. A second way teachers can help students make sense of the mathematics is by carefully selecting the representations they use with students. National documents recommend that instructional programs should enable all students to use representations to model and interpret mathematical phenomena (NCTM, 2000; CCSSI, 2010). While there are many different types of mathematical representations, in many cases these concrete representations take the form of manipulatives and or graphical representations displayed via technology. Manipulatives must be carefully used in the classroom. “In some instances, children are taught to use concrete materials as the only way to solve a problem, and such materials may come to replace the child’s thinking rather than represent it. As a result, the materials may actually interfere with learning” (Fennell & Rowan, 2001).

This can occur because “in the classroom, educators often use supports without recording anything except the answer at the end, leading students to use written methods without linking them with the steps taken using the supports” (Fuson, 2003). Physical materials are not automatically meaningful to students and need to be connected to the situations being modeled (NRC, 2001). In all explanations it is important to link the math drawing or other visual support to the formal math method for each step of that method. It is this tight linking that enables the meanings for the visual or contextual supports to become attached to the formal math method and notations and thus advance student understanding (Fuson & Murata, 2007).

Manipulatives are simply an instructional tool used at the time an abstract concept is being taught to give students a concrete representation of that concept. Manipulatives do not replace formal mathematics, but rather represent formal mathematics and the bridge between the two must be made for the students by the teacher. The power in manipulatives (representations) lies in the careful orchestration of the task by the teacher and thoughtful reflection by the students (Roberts, 2007). In particular, math talk can support students in transforming their understanding of representations (Chapin, O’Connor, & Anderson, 2003). It is essential that teachers, through discussions and written materials, support students in making the explicit
construction of links between manipulatives (representations) and the related symbol procedures (Ma, 1998).

Guided Practice

Guided practice is an essential component of effective lessons. Fuson (2003) has pointed out that helping students build initial correct methods is much easier than correcting errors. Carefully designed guided practice and support during learning are important aspects of developing mathematical proficiency. It is during this phase of guided practice that teachers provide students with scaffolded support as students gradually assume more independence. Practice is important, but effective practice is supported by careful monitoring and help that is focused on doing mathematics with understanding (Fuson, 2003).

Contrary to popular belief, practice does not make perfect, it makes permanent. It is important not to rush to independent practice because repetitive practice will “freeze” a student at his/her current level of understanding (Brownell, 2007). Guided practice therefore should always end with a “check for understanding” (formative assessment), followed by any necessary re-teaching, before independent practice is assigned.

Closure/Summary

Lesson summary is another opportunity to help students recognize the key ideas in a lesson. Research indicates that teachers in Japan summarize lessons, and summarize key points during lessons, more than teachers in any other country (NCES, 2003). Student participation in the closure process is critical to their assimilating and gaining a true understanding of the lesson. Students must be active agents in analyzing, summarizing, and connecting what they have just learned (Wolf & Supon, 1994). Effective teachers use student information from ongoing assessment processes, connected to the lesson objectives, to prompt students through key questions to summarize what they have learned in a given lesson.

Independent Practice

“Nothing flies in the face of the last 20 years of research more than the assertion that practice is bad. All evidence, from the laboratory and from extensive case studies of professionals, indicates that real competence only comes from extensive practice. In denying the critical role of practice one is denying children the very thing they need to achieve real competence” (Anderson, Reder, and Simon, 1998). “It is an error to insist, to quote some, that ‘there is no place for drill in the modern conception of teaching.’ True, there is no place for unmotivated drill on ill-understood skills; but the statement goes too far in saying that there is no place at all for repetitive practice (Brownell, 2003).

Practice only drifts into the arena of mindless drills when students practice things they do not understand. If the Guided Practice phase of the lesson was effective, then independent practice is not only effective, but the amount of independent practice necessary to ensure mastery is actually reduced. It is only when students practice procedures they do not understand that they need extensive practice so as not to forget the steps (NRC, 2001). If students seem to need
massive amounts of practice in order to learn something, that is more often than not an indicator that the instruction was insufficient to generate the level of initial understanding necessary to make independent practice effective.

Homework

Practice is important, but not without understanding (Larson, 2011). Once students understand a computational procedure, practice will help them become confident and develop mastery. However, practice without understanding may be detrimental to students’ understanding, and in many cases avoiding this danger means that instruction should place greater emphasis on guided practice—practice that is supported by monitoring and feedback—prior to independent practice (Fuson 2003; NRC 2001). When students mimic a procedure without understanding, they often have difficulty going back later and building understanding (Fuson 2003). Drilling students on facts and procedures without emphasizing understanding also leads students to think that memorization is the key to mathematical proficiency and does not help them understand that mathematics is about thinking and reasoning, as emphasized in the NCTM Process Standards and CCSSM Standards for Mathematical Practice. Distributed practice over time with feedback promotes student retention and transfer of knowledge (Pashler et al., 2007).

The research evidence indicates that homework can be effective in improving students’ achievement on school-based assessments. In a recent summary of the research, Cooper (2008) found a positive relationship between the amount of homework that students do and their achievement, with short practice assignments being most effective in the elementary grades, up to 90 minutes of homework being most effective in the middle grades, and up to two hours being most effective in high school. Another finding from the research is that homework is most effective when teachers provide reactions to students’ homework on a daily basis and give students written descriptive feedback that goes beyond simply marking their work as correct or incorrect (Davies 2007; Marzano 2006; Shuhua 2004).

The majority of instructional time at school should be devoted to new instruction and guided practice. District policy 6550 addresses homework and states that “School homework should be related to the curricular objectives and be consistent with research guidelines. The assignment of homework is encouraged to aid student learning.”

With district policy and research findings in mind (Sutton & Krueger, 2002; Marzano, Pickering, & Pollock, 2001; O’Connor, 2002), the district makes the following recommendations with respect to mathematics homework:

- Homework is independent practice of skills already learned in school. The purpose of independent practice is the development of mastery. It is essential that significant guided practice with feedback and corrective instruction be completed prior to assigning independent practice. The amount of guided practice required prior to assigning independent practice will vary according to the difficulty of the concept/skill.

- It is a district expectation that students in grades 6-12 enrolled in a mathematics class will have homework assigned nearly every day.
• The fact that some students will not complete and return homework is not an excuse for not assigning independent homework. Failure to assign homework because some students will not return it sets an artificially low expectation for all students.

• It is important to remember that homework is most effective when it is promptly commented on by the teacher and the results used to guide future instruction. It is a waste of precious instructional time to “check” or “grade” student papers in class.

• How do I grade homework? The important thing about homework is that teachers collect it, evaluate it, and use it to guide instruction. Students do need some form of timely feedback to make the work meaningful. Teachers may choose to spot check a subset of critical problems, i.e. it is not an expectation that every homework problem will be corrected everyday. However, it is an expectation that teachers will collect and process homework daily. Homework is a formative activity designed to foster student mastery.

### Mathematical Processes and the Standards for Mathematical Practice

Around the outside of the five components (see the diagram on p. 26) are the five NCTM (2000) process standards. These process standards represent how students are to experience the mathematics and develop their understanding and proficiency:

- **Problem Solving.** Problem solving is an integral part of all mathematics learning and therefore should not be isolated from the content. Emphasizing problem solving means that students have opportunities to build mathematical knowledge through problem solving; that students solve problems that arise in mathematics and in other contexts; that students apply and adapt a variety of appropriate strategies to solve problems; and that students monitor and reflect on the process of mathematical problem solving.

- **Reasoning & Proof.** Being able to reason is essential to understanding mathematics. Emphasizing reasoning and proof means that students have opportunities to make and investigate mathematical conjectures and develop and evaluate mathematical arguments.

- **Communication.** Communication is an essential part of students’ mathematics education and is the primary means by which children share and clarify their understanding. Emphasizing communication means that students have the opportunity to organize and consolidate their mathematical thinking through communication; that students communicate their mathematical thinking coherently and clearly to peers, teachers, and others; that students analyze and evaluate the thinking and strategies of others; that students use the language of mathematics to express mathematical ideas precisely.

- **Connections.** When students can connect mathematical ideas, their understanding is deeper and more lasting. Emphasizing connections means that students have opportunities to recognize and use connections among mathematical ideas; understand how mathematical ideas interconnect and build on one another to produce a coherent whole; recognize and apply mathematics in contexts outside of mathematics.
• **Representation.** The ways in which mathematical ideas are represented is fundamental to how students understand and use those ideas. Emphasizing representation means that students have opportunities to create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; use representations to model and interpret mathematical phenomena.

The process standards are linked to the Common Core State Standards for Mathematics [CCSSM] Standards for Mathematical Practice. The Standards for Mathematical Practice represent ways in which students are to engage with the content standards in order to develop a deep understanding of mathematics and associated habits of mind. Planning to engage students in these practices should be a component of teachers lesson planning. The eight standards for mathematical practice are described below.

1. **Make sense of problems and persevere in solving them.** Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and changes course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculators to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. **Reason abstractly and quantitatively.** Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize – to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents – and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. **Construct viable arguments and critique the reasoning of others.** Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical
progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and – if there is a flaw in an argument – explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4. **Model with mathematics.** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. **Use appropriate tools strategically.** Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. **Attend to precision.** Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own
reasoning. They state the meaning of symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. **Look for and make use of structure.** Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see $7 \times 8$ equals the well remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as $2 \times 7$ and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back from an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as $5$ minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers $x$ and $y$.

8. **Look for and express regularity in repeated reasoning.** Mathematically proficient students notice if calculators are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through $(1, 2)$ with slope 3, middle school students might abstract the equation $(y - 2)/(x - 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x - 1)(x + 1)$, $(x - 1)(x^2 + x + 1)$, and $(x - 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

**Behavior, Effort, Participation, and Extra Credit**

Achievement alone – the student’s mastery of district math objectives -- should be the basis for his/her grade. Effort, participation, attitude, and other personal or social characteristics are inappropriate components of a grading plan that is based on achievement. Although these factors may contribute to a student’s achievement, the interpretation of these characteristics varies widely from teacher to teacher and including any of them blurs a student’s true academic achievement and the meaning of a grade.

Similarly, extra credit should not be a part of a student’s grade as it frequently inflates a student’s grade and does not adequately reflect a student’s mastery of the district objectives. As Stiggins (2001) has written, “some teachers try to encourage extra effort on the part of their students by
offering extra credit opportunities … [however] if grades are to reflect achievement, you must deliver the consistent message that the more you learn, the better your grade … to communicate effectively, grades must reflect the amount learned – not how much work was done to accomplish the learning.” Therefore, the practice of including “extra credit” in a student’s grade is not permitted.

**Effective Use of Instructional Time**

Instructional time is limited and must be carefully used. According to the *1999 TIMSS Video Study of Eighth-Grade Mathematics Teaching*, high performing countries spend more of their instructional time on new material than they do on review. For example, teachers in Hong Kong and Japan spend up to 76% of lesson time on new content. In the United States math teachers typically spend 50% or less of lesson time on new content and the rest reviewing previous content (going over homework).

Effective teachers spend more time discussing new content and less time discussing homework; highly effective teachers seldom if ever spend instructional time correcting homework. Although it is important to give students an opportunity to discuss homework, the amount of time dedicated to this task must be carefully monitored. In order to protect instructional time for new content many teachers correct a sample of homework problems (themselves) and move the discussion to homework to the end of the lesson to protect new content instructional time. Carefully chosen warm-up problems can provide the review necessary to transition directly into new content without discussing homework at the beginning of the lesson.

**Effective use of PLC Time**

One of the most significant challenges facing mathematics education in the U.S. is the inconsistency in instructional effectiveness (Loveless, 2012; Morris & Hiebert, 2011). Therefore, it is a district expectation, and teachers have professional responsibility (Stigler & Hiebert, 1999), to collaborate to ensure consistent expectations (e.g., grading, homework, testing) and work on instructional strategies and lesson designs. Research indicates that when teachers work together in professional learning communities that collegial support enables individual teachers to consider and revise their classroom practice confidently; that they take more pride in their department and enjoy teaching more; that student expectations become more consistent; and that student learning is positively impacted (Kanold and Larson, 2012; McLaughlin and Talbert, 2001).

It is the Math Curriculum Department’s recommendation that secondary math PLCs focus on lesson design and reflection. The essential factor in growth and improvement in teaching is lesson preparation and the analysis of lesson outcomes both during and after each lesson (NCTM, 2007). Each year, each course-based PLC should select 5-10 critical lessons, based on assessment data, and focus on the development of extensive lesson designs for these critical topics. This type of intensive lesson planning is not only a high-leverage instructional strategy, but it also prevents the degradation of PLC time into mere story-swapping and the sharing of materials (Kanold & Larson, 2012).

**Calculator Guidelines**

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Technology is changing the ways in which mathematics is used and is driving the creation of new fields of mathematical study. Consequently, the content of mathematics programs and the methods by which mathematics is taught and student learning is assessed are changing. The capacity for the appropriate use of technology to develop, enhance, and expand students' understanding of mathematics is great. A comprehensive mathematics curriculum should help students learn to use calculators and other technological tools. These tools are a part of many aspects of students' education and will be a standard part of how they study mathematics and science and how they do mathematics in the workplace. It would be remiss to not make their use a part of contemporary mathematics education.

At the same time, there are still many mathematical procedures and concepts that students must learn and be able to use without depending upon the use of calculators. Clearly, the availability of calculators does not and should not replace the need for students to learn basic facts, to compute mentally, or to do reasonable paper and pencil computation. For example, while everyone should be able to do simple computations with fractions by hand, techniques for finding square roots by hand are no longer a part of the curriculum. Sound mathematics instruction uses technology to enhance teaching, but does not use it to eliminate the need to teach students to think or to compute. Therefore, the professional question of when to use technology and when not to use it is one that mathematics teachers must face almost daily. In general, the appropriateness of calculator use at all levels is judged in terms of the instructional objective. If the instructional objective is focused on solving problems in context and not the computations embedded within the problem, then the calculator may be an appropriate tool. If the instructional objective is the mastery of a specific skill or procedure, then the calculator is an inappropriate tool.

To further clarify the appropriate use of calculators, the Lincoln Public Schools Mathematics Curriculum Department has established the following guidelines with respect to calculator use.

Grades K-3

The major objective of primary school mathematics is the development of number sense. Number sense evolves from concrete experiences and takes shape in oral, written, and symbolic expression. Students at this level must develop mastery of computational procedures without the use of a calculator and consequently the use of calculators in grades K-3 is a very minor part of the curriculum. Occasionally, teachers may use simple four function calculators with students to explore and experiment with mathematical ideas such as patterns and numerical properties or to permit students to solve problems that involve more complex computations.

Specifically, the district endorses the following practices at the K-3 level:

- It is appropriate for teachers to occasionally use calculators with students to explore and experiment with mathematical ideas such as patterns and numerical properties. This use should support a specific instructional objective and the use of calculators should be under the careful supervision of the teacher. In particular, some modules in the differentiated curriculum will require calculator use.
• Because of the importance of teaching basic facts and computation skills at this level, it is appropriate for teachers to carefully regulate student access to calculators. In most cases, it would be inappropriate for students to have "open" access to calculators at this level.

• Students at this level are not permitted to use calculators on any portion of the ITBS.

• Because calculator use is carefully regulated by the teacher at this level, it is not necessary for every teacher to have a complete classroom set of calculators.

Grades 4-6

In the intermediate grades, instruction with calculators has increased potential to enhance and expand students' understanding of mathematics. However, this instruction must focus on developing students' ability to know how and when to use a calculator. Skill in estimation and the ability to decide if the solution to a problem is reasonable, and skill in selecting the appropriate solution strategy (mental math, paper and pencil, or calculator) are essential adjuncts to the effective use of the calculator. As such, calculators are simply another tool that is made available to students when they are working in a problem solving context and the emphasis is on their ability to interpret a problem situation and determine the procedure required to solve the problem. Calculators at this level should never be used to replace the recall of basic facts and the ability to perform routine computational procedures either mentally or with paper-and-pencil.

Specifically, the district endorses the following practices at the 4-6 level:

• It is appropriate for students to use calculators under teacher direction to explore and experiment with mathematical ideas such as patterns, numerical and algebraic properties, and functions.

• It is appropriate for students to use calculators under teacher direction when focusing on problem-solving processes rather than the tedious computations that often develop when working with real data in problem situations.

• It is appropriate for students to use calculators under teacher direction for the purpose of gaining access to mathematical ideas that go beyond those levels limited by traditional paper-and-pencil computation.

• It is a district expectation that students will be able to perform basic computational procedures without the aid of a calculator. This includes:

  Grade 4
  • Recall of basic multiplication facts through 12.
  • Three digit addition and subtraction.
  • Decimal addition and subtraction to the hundredths place.
  • Up to a 3 digit number times a 2 digit number.
  • Division with a 1 digit divisor.
  • Addition and subtraction of fractions with a common denominator.
Grade 5
- All grade 4 skills.
- Four digit addition and subtraction.
- Addition of fractions without a common denominator.
- Decimal division with a dividend to the tenths place.
- Division with a two-digit divisor.
- Multiplication involving powers of ten.
- Decimal multiplication with one factor to the hundredths place.

Grade 6
- All grade 5 skills.
- Decimal division with dividend to the hundredths place.
- Addition of mixed numbers.
- Multiplication of fractions.
- The quotient of two fractions.
- Decimal addition and subtraction to the thousandths place.
- Decimal multiplication

Grades 7-8

Grades seven and eight represent transition years with respect to the use of calculators. In these grades it is still expected that students will carry out certain procedures without the use of a calculator. However, by eighth grade the curriculum no longer focuses on computational skills and shifts to preparation for algebra and geometry. Therefore, the calculator can serve as a tool that may give students who have not yet mastered certain skills access to upper level mathematics.

It is a district expectation that students will be able to perform basic computational procedures without the aid of a calculator. This includes:
Grade 7
• All grade 6 skills.
• Decimal addition and subtraction to the hundredths place.
• Product of a mixed number and a whole number.
• Product of two mixed numbers.
• Quotient of a mixed number or simple fraction divided by a whole number.
• Decimal multiplication (thousandths place times the tenths place).
• Finding the percent of a number.

Grade 8
• All grade 7 skills.
• Decimal division (hundredths place dividend, tenths place divisor).

In addition, the following guidelines should be kept in mind:

• It is appropriate for students to use calculators to explore and experiment with mathematical ideas such as patterns, numerical and algebraic properties, and functions.

• It is appropriate for students to use calculators when focusing on problem-solving processes rather than the tedious computations that often develop when working with real data in problem situations.

• It is appropriate for students to use calculators under teacher direction for the purpose of gaining access to mathematical ideas that go beyond those levels limited by traditional paper-and-pencil computation.

• The primary objective of seventh and eighth grade mathematics is not the mastery of computational skills. Some periodic practice of previous skills and those listed above is appropriate, but should not become the dominant feature of the curriculum.

• Students in algebra should have routine access to calculators, except with the objective is focused on computation, for example simplification of radicals.

• For some students whose computational ability is limited, tools such as calculators assist students in studying challenging mathematics despite their difficulty with computation. Therefore, it is appropriate for students with special needs and others to have access to calculators so that their opportunity to study higher level mathematics is not restricted.

• Teachers of mathematics courses at all levels have the right to restrict the use of calculators in their classroom in order to ensure that students understand certain mathematical concepts and are able to perform routine symbolic procedures.

Grades 9-12

In grades 9-12, the math curriculum focuses on approaching problems numerically, algebraically, and graphically. Students are encouraged to use these different approaches to examine problems from different perspectives and find multiple methods to solve problems. In order to approach
problems both numerically and graphically, students may make extensive use of hand held graphics calculators.

Although it remains important for students to be able to perform routine computations both mentally and with paper and pencil, at the high school level students will also make extensive use of scientific calculators throughout the curriculum. This practice gives all students access to upper level mathematical concepts.

Specifically, the district has established the following practices at the high school level:

- The use of laptop computers or calculators with algebraic capacity (e.g., TI-92, TI-89, or TI Voyager) is not permitted on tests and quizzes unless the classroom teacher announces a policy that permits their use in some circumstances. This restriction is usually necessary because the use of this technology often permits a student to find answers to many problems without understanding the underlying mathematical concepts or processes.

- In geometry, students and teachers may use the TI-92 as an interactive and dynamic environment for the investigation of geometric properties and relationships. The Geometer's Sketchpad or GeoGebra serves a similar function.

- Students in algebra courses and courses that build on algebra should have access to graphing calculators, although it is not required that they purchase their own calculator.

- Students in precalculus and calculus will make extensive use of graphing calculators and the district provides students with this technology. Students are not required to purchase their own calculator. The recommended model is the TI-83+.

- Teachers of mathematics courses at all levels have the right to restrict the use of calculators in their classroom in order to ensure that students understand certain mathematical concepts and are able to perform routine symbolic procedures. For example, precalculus teachers may assess student knowledge of trigonometric values without the aid of a calculator and calculus teachers may use the UNL Gateway Exams to assess student knowledge of derivatives and integrals without the aid of a calculator.

- High school students are permitted to use certain calculators on the tenth grade PLAN (pre-ACT) test, the ACT, the SAT, and the UNL Math Placement Exam.

  The ACT, PLAN, and AHSME exclude the use of the TI-89.

All tests exclude the use of the TI-92.
Multicultural Connections

It is important that students appreciate mathematics in its historical context (NCTM, 1989). Students should be aware of the importance of mathematics throughout history, and they should have a sense of the evolution of mathematical thought over time (Gardella, et al., 1992). Most importantly, students should come to understand that the body of mathematical knowledge we have today is not the work of a select few, but rather the result of a vast and culturally diverse group of men and women from all around the world (Gardella, et al., 1992). Learning about the contributions of various cultures to the development of mathematics can lead students to a better understanding of mathematical concepts, as well as an appreciation for the cultures involved (Gardella, et al., 1992).

The district has outlined 18 student proficiencies with respect to multicultural education. Mathematics instruction emphasizes the first of these 18 proficiencies. This proficiency states that “students will know the histories, cultures, and contributions of African Americans, Asian Americans, European Americans, Hispanic Americans, and Native Americans.” To support this proficiency, it is a major outcome of each 9-12 mathematics course that “students will know and value the contributions to mathematics made by persons of diverse racial, ethnic, and cultural backgrounds.”

Although the mathematics textbooks in use include many cultural and historical references, an audit of the curriculum indicated the textual references are insufficient to achieve the district’s multicultural education mathematics outcome. To further infuse the mathematics curriculum with the histories and contributions of persons of diverse racial, ethnic, and cultural backgrounds, specific multicultural connections can be found on DocuShare. This information can be used to transform the mathematics curriculum with the histories and contributions of diverse perspectives and can serve as an appropriate part of the teacher’s introduction of the listed mathematics topics.

Some resources that outline the contributions other cultures have made to the development of mathematics and teaching mathematics for multiple cultural perspectives are listed below:


Where Can We Find Research to Support our SIP/PLC?

Increasingly, education leaders look to research when making educational decisions. It is important to understand what research can and cannot do. As Hiebert (1999) and Marzano (2007) have discussed, teaching takes place in a complex environment, and research does not provide definitive answers to questions. Instead, recommendations based on research rest on probability estimates—that is, what is likely to improve student learning—and recommendations will change over time as new information emerges. However, we do know a good deal from the research about effective mathematics teaching and learning (Reed 2008). This guide cites relevant research whenever possible. In addition, one of NCTM’s strategic initiatives in the last half-decade has been to link research and practice. As part of this initiative, NCTM has published a number of resources that you can consult to find additional research to improve teaching and learning:

- Disrupting Tradition: Research and Practice Pathways in Mathematics Education (Tate, King, and Anderson 2011)
- Teaching and Learning Mathematics: Translating Research for Elementary School Teachers (Lambdin and Lester 2010)
- Teaching and Learning Mathematics: Translating Research for School Administrators (Charles and Lester 2010)
- Second Handbook of Research on Mathematics Teaching and Learning (Lester 2007)
What Are Effective Strategies to Support Students Who Struggle?

In general, students with difficulties in mathematics should receive instruction that emphasizes all aspects of mathematical proficiency, with the same teaching and the learning principles applying to all students, including those with special needs (Baroody 2011). In a recent summary of the research on specific instructional strategies that have consistently been found to be effective in teaching students who experience difficulties with mathematics, Gersten and Clarke (2007, p. 2) reached the following conclusions:

For low-achieving students, the use of structured peer-assisted learning activities, along with systematic and explicit instruction and formative data furnished both to the teacher and to students, appears to be most important. For special education students, explicit, systematic instruction that involves extensive use of visual representations appears to be crucial. In many situations with special education students, it is often advantageous for students to be encouraged to think aloud while they work, perhaps by sharing their thinking with a peer. These approaches also seem to inhibit those students who try too quickly and impulsively to solve problems without devoting adequate attention to thinking about what mathematical concepts and principles are required for the solution. Instruction should ideally be in a small group of no more than six and (a) address skills that are necessary for the unit at hand, (b) be quite explicit and systematic, and (c) require the student to think aloud as she or he solves problems or uses graphic representation to work through problem solving options. Finally, it should balance work on basic whole-number or rational-number operations (depending on grade level) with strategies for solving problems that are more complex. These criteria should be considered in evaluating intervention programs for working with these types of students.

Another recent review of the research on instruction for students with learning disabilities in mathematics has similarly found that a systematic and explicit approach to instruction is most effective (Gersten et al. 2009a). This approach is characterized by teacher modeling, followed by students’ practicing with similar problems and receiving specific and immediate feedback from the teacher as they verbalize and explain their solutions and understandings, followed by ongoing cumulative review of key concepts (Clarke et al. 2011).

NCTM recently published a useful resource, Achieving Fluency: Special Education and Mathematics (Fennell 2011), which offers teachers and leaders additional specific strategies to support learners who struggle with mathematics.
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