Estacada School District Mathematics Education Plan 2004-2006

Report to the Estacada School District
Board of Directors
June 9, 2004

Prepared by:
The Mathematics Education Sub-Task Force of the
Academic Enhancement Task Force

Numbers are the highest degree of knowledge. It is knowledge itself.

– Plato

Executive Summary

In January 2004, a sub-task force was formed to define a path for the Estacada School District regarding the district's mathematics education programs. This sub-task force was created as a component of the Academic Enhancement Task Force, which was created in October 2002. The recommendations contained in this report reflect the consensus of the sub-task force. The Plan has an anticipated implementation timeframe of two years, at which time it should be reviewed and extended, if necessary.

Mathematics Education Sub-Task Force Members

School Board	**Representing**
David Bugni	Director & Mathematics Education Plan Facilitator
Mark Greene	Director
Administrators	
Mike Call	Superintendent
Dr. Howard Fetz	The District, Curriculum & Special Services Director
Gary Lewis	High School, Principal
Bob Espenel	Junior High School, Principal
Kevin Olds	Clackamas River Elementary School, Principal
Tina Rhue	River Mill Elementary School, Principal
Jan Jaqua	Eagle Creek Elementary School, Principal
Licensed Staff	
Boge Saffores	High School, Mathematics
Frank Franklin	Junior High School, Mathematics
Sally Woods	Junior High School, Mathematics
Elizabeth Warren	Junior High School, Mathematics
Scott Sullivan	Secondary Schools TOSA 7-12
Lori Hughes	River Mill Elementary School
Lee Phillips	Eagle Creek Elementary School
Sarah Hastings	Eagle Creek Elementary School
Loyce Puckett	Eagle Creek Elementary School

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Appendices

The Mathematics Education Plan Process

In the planning process for implementing a successful mathematics education program, the district must first have a clear understanding of its mathematics education goals. The district believes these goals to be multi-faceted and the components are described within this report.

The names of members of the District's Mathematics Education Sub-Task Force are listed in the front of this report. The sub-task force includes representation from the school district board of directors, administration and licensed staff.

The Mathematics Education Sub-Task Force drew from printed material and presentations by people with direct knowledge and experience with various aspects of planning for mathematics education.

Meetings of the Mathematics Education Sub-Task Force or the Academic Task Force that dealt with this report were held on the following dates at the school district's central office:

January 22, 2004	February 9, 2004
March 1, 2004	March 8, 2004
March 15, 2004	March 29, 2004
March 12, 2004	April 12, 2004
May 10, 2004	

All meetings of the Mathematics Education Sub-Task Force were open to the public.

The findings and recommendations presented in this report reflect the views of the entire Mathematics Education Sub-Task Force. Task force members were invited to add any qualifying comments if they wished to do so.

District Philosophy Regarding Mathematics Education

Philosophy Regarding Program Design, Administration and Management

Given our community's close proximity to the Portland area and the numerous research and high technology industries located there, as well as the district's recognition of the importance of mathematics-related careers to our nation's overall economy and the need to remain the world's technological leader, this aspect of our student's education should become a major focus. Additionally, as our society becomes more complex, vocational occupations require a higher level of mathematical knowledge. As a result, a basic understanding of these issues must be acquired by all students in order to become effective citizens.

The district believes that appropriately qualified personnel must instruct students in mathematics. Mathematics education must be integrated into the general education program and should create meaningful linkages at all grade levels. The mathematics program must also include positive working relationships with interested members of the community in order to build relationships that foster mentoring and other volunteer efforts. Adequate resources and materials must be provided to support the efforts of any successful mathematics program.

The district believes that a continuum of mathematics education must exist across grades K-12. Appropriate educational opportunities must be provided in the regular classroom and extend into extra-curricular activities. Mathematics concepts must be built upon year after year.

At the junior high and high school levels, each mathematics department should have a department chair. The chair's duties are to assist the school's principal in understanding the department and to specifically enhance the quality of instruction in that department. The department chair should lead the department, in part by constantly evaluating the curricula and implementing improvements where required, by attending regional mathematics conferences on a periodic basis, by becoming well-versed in all mathematics fields taught, by aggressively seeking outside funding sources, and by assisting in the broadening and deepening of mathematics knowledge and teaching effectiveness of mathematics teachers in the building.

Philosophy Regarding Curriculum and Instruction

The district believes that mathematics education is fundamental to a student's education. A study conducted by the Academic Enhancement Task Force in 2003 found that the parents of students within this school district believe that mathematics is ranked third in importance of academic subjects taught, behind reading and writing. The content standards prescribed by the Oregon Department of Education direct, to some degree, the content of our district's mathematics education.

The mathematics education at the high school level should drive mathematics education at all grades. If the program is strong at the high school, it demands that students be prepared to meet that challenge by having experienced a challenging program in their younger years. Conversely, if the mathematics experience in the lower grades is challenging and stimulating, this will require that the program at the high school level also meet this level of intensity. Strong leadership in mathematics within the district must come from the high school level. It is the pinnacle of our education establishment in Estacada and as a result should be the focus of the district's mathematics program.

The high school mathematics department faculty should constantly be seeking out opportunities for promoting the subject, acquiring additional funds, attending professional development functions, and assisting the other schools in the district in mathematics education. Mathematics teachers should possess a breadth and depth of mathematical knowledge, in order to relate the various mathematics disciplines to one another and promote the interconnectedness of mathematical fields. The district should promote student mathematics competitions at all levels, particularly at the junior high and high school levels.

At the high school level, the following courses in mathematics are offered:

Mathematics Foundations
Math I and II
Geometry
Advanced Algebra
Pre-calculus
Calculus I and II

To further stimulate a student's interest in mathematics, additional enrichment classes should be offered to fully challenge the abilities of those students that are capable of succeeding in the subject. Honors courses in algebra, geometry, and advanced algebra should be implemented. Studies have shown that the percentage of students enrolled in honors classes should constitute approximately 15% to 20% of the student population for a particular grade. (The current pre-calculus and calculus course could be considered, or slightly modified to be, honors courses.) Similarly, additional courses to stimulate the interest of other students in mathematics should also be implemented at the high school level, such as statistics and an applied math class exploring topics in consumer or business mathematics.

At all levels, additional consideration should be given to integrating mathematics with other subjects. Examples include: science, music, social science, writing, vocational arts (metals and electronics), and the arts.

Differentiated instruction should also be promoted as a meaningful tool for teaching mathematics. Please refer to the district's recently completed TAG (Talented & Gifted) Plan for additional information.

At the elementary school level, consideration should be given to accelerating and enriching those students that demonstrate greater mathematical ability. This is currently being implemented to varying degrees at each school.

In a recent article titled, "The Arithmetic Gap", in the February 2004 edition of the journal *Educational Leadership*, the question discussed was, "Why does arithmetic matter?" A number of answers were provided:

1. Computation skills are necessary to advance in mathematics and the sciences. Learning mathematics is an incremental process. Eighth graders who cannot do basic arithmetic with ease, who cannot find the right answer quickly and confidently without a calculator, will be hampered in their efforts to learn algebra and geometry in high school. Without some proficiency in algebra, students will have little grasp of calculus, physics, or chemistry and little chance of succeeding in college mathematics and science courses.
2. Computational skills are an increasingly important predictor of adult earnings.
3. Computational skills promote equity in math achievement.

The district believes that a student's mastery of basic computational skills is extremely important and effort should be focused in that area at the elementary level.

Philosophy Regarding Professional Development

The district believes that professional development in mathematics is very important. This professional development should be ongoing and include both in-district and out-of-district experiences. Outside consultants should be retained to introduce and assist the district in developing best practices. In addition, in-house "experts" should be utilized to maintain, refine and continue staff development in mathematics. These "experts" should also be provided with ample opportunities to hone their skills and develop curriculum while attending out-of-district workshops and classes.

Findings Regarding Planning Requirements

1.1. District-wide

1.1.1. The district currently lacks a comprehensive plan (scope and sequence) for mathematics education spanning from kindergarten through the 12th grade.

1.1.2. The Estacada School District Goals, as identified by the School Board for the 2003-2004 year, identified as their number one goal to increase the number of accelerated academic options in science and math.

1.1.3. The following items were extracted from a tabulation of proficiency patterns derived from a recently-conducted K-12 survey. While the survey is incomplete, not balanced in its presentation of comments, and at times the recommendations do not follow from the findings, some information can be learned from the results obtained:

Table 1

Mathematics Proficiency Patterns (K-12)

Results as presented in the district's recently acquired proficiency pattern survey

Grade	Comments identifying strengths of students entering grade noted	Comments identifying weaknesses of students entering grade noted	Math-Related Comments
1st	Mathematics	None listed (Are there any?)	
2nd	Mathematics concepts & facts (in general)	Ones & tens place value	
		Coin values, conventions	
3rd	5's & 10's in multiplication	Estimation	More materials that possible integrate more than one subject.
	Algebraic patterns	Addition & subtraction facts	
	Preparation for multiplication	Algebraic relations	
	Geometry	Measurement	
	Estimation & calculation	Probability & Statistics	
	Operations & properties	Problem solving	
	Transformation & Symmetry	Place values	
4th	Addition	Problem solving	
		Multiplication, division & subtraction	
		Math facts	
		Place value	
		Measurement, decimals, fraction	
		Probability & statistics	

5th	Addition & subtraction	Multiplication facts	
	Determine factors	Long division & fraction	
	Estimation	Problem solving	
		Finding mean, median, mode	
		Place value	
		Rounding numbers	
6th	Problem solving	Multiple digit multiplication	Math facts & concepts should be mastered before moving on to new material
		Long division	
		Borrowing in subtraction	
		Problem solving verification	
7th & 8th	Strengths ranked from highest to lowest: statistics, patterns & functions, display & collecting data, transformational geometry, and Euclidean geometry	Weaknesses ranked from greatest to least: fractions, division, rates (ratios & percents), computation & estimation, number sense, measurement systems, direct & indirect measurement, the Oregon problem solving model	Focus on the basics. Time to plan with elementary teachers. More time in elementary school spent on arithmetic and reading and less on science & social science.
9th – 12th	Foundations: fractions, percents, probability & graphs	Foundations: graphing lines, solving equations, problem solving	Communicate with 7 & 8 grade teachers. Reduce use of calculators.
	Algebra 1: integer operations, evaluating expressions, combining like terms, solving simple equations, graphing order pain (?)	Algebra 1: graphing lines, problem solving	
	Algebra 2: solving equations & graphing, all of the above, some problem solving	Algebra 2: complex problem solving (combinations), translations of graphs	
	Single digit addition	Operations with fractions	
		Staying organized	

1.2. High School

1.2.1. The following mathematics courses are taught annually at the high school:

Math Foundations (1 trimester)
Math I & II Topics (2 trimesters)
Geometry (2 trimesters)
Advanced Algebra (2 trimesters)

Pre-calculus (2 trimesters)
Calculus I (2 trimesters)
Calculus II (1 trimester, independent study)

1.2.2. The high school does not have any extra-curricular activities related to mathematics (such as a math club).
1.2.3. There exists minimal career guidance about the fields of science or engineering.
1.2.4. The percentage of students meeting or exceeding the standard on the 10^{th} grade multiple choice math benchmark test has been steadily increasing from less than 10% in 1994 school year to a high of 50% in 2000 school year. The past two years have seen a drop in this score to about 33%, which is below the state average.
1.2.5. The percentage of students meeting or exceeding the standard on the 10^{th} grade math problem solving benchmark test steadily increased from about 50% in 1998 school year to a high of 56% in 2000 school year. The past two years have seen a drop in this score to about 30%, which is below the state average.
1.2.6. The current number of credits in mathematics required for graduation is two.
1.2.7. Honors math classes currently do not exist in the subjects of geometry or advanced algebra.
1.2.8. Mathematics is minimally integrated into other subjects.
1.2.9. High school mathematics teachers need more time to plan with the Junior High math teachers.

1.3. Junior High

1.3.1. Class sizes are very high (30 students or more), and have been so for the past several years. (this is true in a number of the departments at the Junior High.)
1.3.2. There are too many mid-level students in the high level classes. This creates a dual problem: it discourages the mid-level students and causes the true TAG students to underachieve.
1.3.3. No extra-curricular activities related to mathematics (such as a math club).
1.3.4. Percentage of students meeting or exceeding the standard on the 8^{th} grade multiple choice benchmark test has been consistently below the state average, with the exception of the 1998 school year.
1.3.5. Percentage of students meeting or exceeding the standard on the 8^{th} grade math problem solving benchmark test has been consistently above the state average.
1.3.6. No defined goal has been set by the district that states the majority of students shall be ready for algebra by the 8^{th} grade.
1.3.7. Mathematics is minimally integrated into other subjects.
1.3.8. An honors math class currently does not exist for algebra. The content is mostly present, but the title of the class has not yet been changed.
1.3.9. High school teachers report that incoming students' greatest weaknesses are in the areas of number sense, units of measurement, and fractions.
1.3.10. Manipulatives for the teaching of some mathematics topics are required. These should have been provided with the most recent math text book purchase.
1.3.11. No tool exists to evaluate 6^{th} grade students entering the junior high math program.
1.3.12. No time exists in the schedule for students to receive help in mathematics (or any other subject) during the school day.
1.3.13. There is not adequate time for the math teachers at the junior high to converse and plan with either the sixth grade or ninth grade teachers.

1.4. Elementary Schools

1.4.1. Percentage of students meeting or exceeding the standard on the 3rd grade multiple choice math benchmark test has been variable, depending upon the school. Both Eagle Creek and River Mill have been above, or at the state average, with Clackamas River showing increasing progress, from being consistently below state average to meeting it. Eagle Creek has had a two year decline in performance.

1.4.1.1. For Clackamas River Elementary School, the relative student performance within each math strand has fluctuated since 1995. Lately, it would appear that geometry, measurement, and algebra are mastered at a higher level than calculation & estimation and statistics.

1.4.1.2. For River Mill Elementary School, the relative student performance within each math strand has fluctuated since 1995, but to a lesser degree than Clackamas River. Lately, it would appear that geometry and measurement are mastered at a higher level than calculation & estimation, algebra, and statistics.

1.4.1.3. For Eagle Creek Elementary School, the relative student performance within each math strand has fluctuated since 1995, but to a lesser degree than Clackamas River. Lately, it would appear that measurement is mastered at a higher level than algebra, calculation & estimation, geometry, and statistics.

1.4.2. Percentage of students meeting or exceeding the standard on the 5th grade multiple choice math benchmark test has been variable, depending upon the school. Both Eagle Creek and River Mill have been above, or at the state average, with Clackamas River showing increasing progress, from being consistently below state average to meeting it.

1.4.2.1. For Clackamas River Elementary School, the relative student performance within each math strand has fluctuated since 1995. Lately, it would appear that measurement, algebra, and statistics are mastered at a higher level than calculation & estimation and geometry.

1.4.2.2. For River Mill Elementary School, the relative student performance within each math strand has fluctuated since 1995. Lately, it would appear that geometry, algebra, measurement and calculation & estimation are mastered at a higher level than statistics.

1.4.2.3. For Eagle Creek Elementary School, the relative student performance within each math strand has fluctuated since 1995. Lately, it would appear that measurement, algebra, and calculation & estimation is mastered at a higher level than geometry and statistics.

1.4.3. Percentage of students meeting or exceeding the standard on the 5th grade math problem solving benchmark test has been consistently below the state average since the 1999 school year (with the exception of River Mill's performance in the 2000 school year).

1.4.4. Junior High school teachers report that incoming students' greatest weaknesses are in the areas of number sense, units of measurement, and fractions.

1.4.5. A calculator usage policy currently does not exist.

1.4.6. Each school has its own program for the acceleration of students with greater math ability. The programs are not identical (considering which grade they begin to take effect).

1.4.7. An analysis of teacher responses from River Mill and Eagle Creek (no responses received from Clackamas River) to a recent survey reveal the following:

1.4.7.1. The Sadlier text appears to need augmentation primarily at the kindergarten level and the first and second grades; then, the need for augmentation diminishes through the sixth grade.

1.4.7.2. Calculator use appears to be minimized, but no consistent standard or guideline exists.

1.4.7.3. Not all teachers are familiar with the NCTM 2000 standards.

1.4.7.4. Integration of math into other subjects is limited.
1.4.7.5. There is limited practice of the acquisition of basic math facts.

1.4.8. Between the three elementary schools, there is not adequate time allotted for teachers to coordinate their activities (scope and sequence, teaching methods, etc.).

Recommendations Regarding Planning Requirements

1.1. District-wide

1.1.1. Implement a district-wide calculator usage policy (refer to Appendix A. for recommended language).

1.1.2. Staff Development

1.1.2.1. Mathematics professional development activities should become a part of an overall district-wide program for all subjects. A professional development plan addressing these needs in a more global sense is currently under development (contact Scott Sullivan for details).

1.1.2.2. The professional development plan component that addresses topics in mathematics should include those areas where students are consistently underperforming, as recognized on state assessment tests and by teacher observations in junior high and high school. Topics to be addressed include: problem solving, number sense, fractions, brain research strategies, and instructional strategies.

1.1.2.3. On-going training in the use of manipulatives should be implemented.

1.1.2.4. Staff development in brain based research teaching strategies should continue district-wide in order to increase the effectiveness of teaching in block schedules. The research indicates that longer class periods, in conjunction with proper teaching strategies, increases student learning.

1.1.3. The district should integrate mathematics into the entire curriculum from K-12. Examples of relevant topics are noted below:

Table 2

Integration of Mathematical Topics into Other Subjects

Grade	Subject					
	Science	Social science	Language Arts	Arts	Music	Vocational Arts
K	No recommendations provided	No recommendations provided	No recommendations provided	No recommendations provided	No recommendations provided	N/A
1st	Sorting, graphs, Fahrenheit & Celsius, Venn diagrams, measurement, estimations, classifying & looking for patterns	Sorting, problem solving, measurement	Use diagrams, count syllables, sorting, draw diagrams & charts for reports	Measurement, geometry, sorting by shapes and color	No recommendations provided	N/A
2nd	Utilize "Simply Science" program, Measuring, Charting and graphing, Tally charts, Formulas, Gauges	Graphs, charts, timelines, Probability in comparisons, Longitude and latitude, Grid maps with coordinates, map scales, Percentages,	Graphs, Charts, Timelines, Tally charts	Tangrams, Geometric art, Symmetry, Fraction robots, Glyphs	Songs for math concepts (See attached index from Anytime Math: Read-Aloud Anthology)	N/A

	(rainfall), Percentages	Secret codes using numbers to figure out social studies questions, dates				
3rd	Utilize "Simply Science" program, Measuring, Charting and graphing, Tally charts, Formulas, Gauges (rainfall), Percentages	Graphs, charts, timelines, Probability in comparisons, Longitude and latitude, Grid maps with coordinates, map scales, Percentages, Secret codes using numbers to figure out social studies questions, dates	Graphs, Charts, Timelines, Tally charts	Tangrams, Geometric art, Symmetry, Fraction robots, Glyphs	Songs for math concepts (See attached index from <u>Anytime Math: Read-Aloud Anthology</u>)	N/A
4th	Utilize "Simply Science" program, Mean, median, mode, range, Creating graphs (pictograph, line, bar, circle), Reading & interpreting graphs, Reading numbers to the billions, Metric & standard measurement, Comparing numerical data	No recommendations provided	Creating tables, Comparing tables and numerical data, Time lines	Measurement of line, angles	No recommendations provided	N/A
5th	Utilize "Simply Science" program, Measuring, Putting data into different formats: graphs, averages, percentages, tables,	Graphs, timelines, charts, Longitude and latitude, Measuring distance, mapping skills, Coordinate maps	Reading charts and graphs, Making timelines from reading historical information, Writing word problems, Communication in problem solving	Fraction sundaes, Geometrical shapes, Perspective drawings (geometry), multiplication houses	No recommendations provided	N/A

	Formula					
6th	Measurement, Graphing, Weights	No recommendations provided	Timelines	No recommendations provided	No recommendations provided	N/A
7th	Measurement	No recommendations provided	No recommendations provided	Tessellations	No recommendations provided	N/A
8th	Use of metric system	Historical topics related to mathematics	Write about famous mathematicians	Polygons, transformations, translations, reflections	Repeating patterns, fractions	N/A
9th	Physical science: weights & measures Biology: heredity, natural selection, populations	See below	See below	See below	See below	See below
10th	Chemistry: periodic law of the elements, basic quantum mechanics Environmental science: magnitudes of pollution types, populations	See below	See below	See below	See below	See below
11th	Physics: the math of space & motion, orbital mechanics, constants of nature, the list is endless	See below	See below	See below	See below	See below
12th	Advanced classes will take effect in the 2005-06 school year in physics, chemistry and biology. Additional opportunities will develop.	Ideas include: longitude, supply/demand, population/food, maps, political economy, warfare, games, probability (vital statistics, demographics, etc.) **(Place topics in the appropriate**	Ideas include: writing about famous mathematicians or events in mathematics, writing about abstract mathematical concepts such as infinity, logic, and the mathematical	Ideas include: the golden ratio, natural base "e" (spirals, etc.), color, aesthetics, proportion, tiling, M.C. Escher **(Place topics in the appropriate grade)**	Ideas include: the mathematics/physics of music – tones, patterns, energy, waves, etc... **(Place topics in the appropriate grade)**	For graphic and vocational arts, the use of math to lay out shapes and calculate geometric properties of those shapes. **(Place topics in the appropriate grade)**

		grade)	works of Lewis Carroll **(Place topics in the appropriate grade)**			

1.2. High School

1.2.1. The Sub-Task Force recommends raising the mathematics requirement for graduation from 2 credits to 3 credits. This will greatly enhance a student's knowledge of mathematics and help to promote a student's consideration of pursuing higher education at a two-year or four-year institution. It will also provide all students with the tools needed to live in a society where increasing reliance upon mathematical principles is required, whether to function in business or to deal with one's own finances. It will further reinforce our desire to indicate to others inside and outside the community that the school district is serious about the academic aspects of our children's education.

We recommend that this program begin during the 2004-2005 school year, becoming completely implemented for the graduating class of 2008.

1.2.2. Consider implementing <u>additional</u> mathematics enrichment classes:

- Honors Geometry (implement in 2004-2005)
- Honors Advanced Algebra (implement in 2004-2005)
- Statistics (new textbooks required) (implement in 2005-2006)
- An applied mathematics class, such as Consumer Math or Business Math (new textbooks required) (implement in 2005-2006)

The honors classes should be constructed and taught differently than the regular classes for the same subject. Based upon discussions with teachers and administrators in other school districts, we recommend that teachers who teach honors classes employ such notions as a different grading scale, a faster pace (allowing more material to be covered in-depth), and time for projects (in-class and independent). Class time should minimize the amount of time spent going over text material. Given the percentage of students enrolled in the honors Pathway (about 15 – 20%), enough students with capable math abilities will be left in the Pathway 1 sequence (refer to table 3, below) to become role models for the other students. Consideration should be given to utilizing the same textbooks as the regular algebra, geometry, and advanced algebra classes, but augment as necessary. The subject matter in the honors algebra, geometry, and advanced algebra classes should parallel that covered in the regular track 1 classes. However, it should diverge where appropriate to provide enrichment. Some suggested areas for enrichment include:

Geometry: Further studies employing two-column proofs and an introduction to geometries other than Euclid's.

Advanced Algebra: Boolean logic (including symbolic logic), group theory, and set theory.

The teaching staff requirements for the proposed new statistics and applied math classes can be achieved by regaining the 0.5FTE in mathematics which was lost several years ago due to budget reductions.

The following schedule (Table 3) should be considered as a basis to implement these classes, in the framework of a broader system of offerings based upon student ability. Students should be allowed to move laterally between pathways, as their abilities dictate. Refer to the population breakdown at the 8th grade level for the recommended distribution of students into each pathway (approximate percentages based upon historical trends, actual percentages will vary from year to year). For clarity and consistency, the following abbreviations are used in the table below to denote the current textbook that will be used:

SF1 = Scott Foresman – Addison Wesley Middle School Math book 1
SF2 = Scott Foresman – Addison Wesley Middle School Math book 2
SF3 = Scott Foresman – Addison Wesley Middle School Math book 3
MDA1 = McDougal Littell Algebra 1
MDG = McDougal Littell Geometry
MDA2 = McDougal Littell Algebra 2

Table 3
Proposed Skeletal Mathematics Framework

Grade	***Pathway 1*** (**65-70% of all students Algebra ready by the 8th Grade**)	***Pathway 2*** (**15-20% of remaining students**)	***Pathway 3*** (**About 10% of remaining students**)	***Pathway 4*** (**About 10% of remaining students**)
3rd Grade	Math 3	Math 4 (begin acceleration of students)	Math 3	Math 3 (may also need to revisit previous grade's topics)
4th Grade	Math 4	Math 5	Math 4	Math 4 (may also need to revisit previous grades topics)
5th Grade	Math 5	Math 6	Math 5	Math 5 (may also need to revisit previous grade's topics)
6th Grade	Math 6	Math 7 **(SF2)**	Math 6	Math 6 (may also need to revisit previous grade's topics)
7th Grade	Pre-Algebra **SF3**	Pre-Algebra Honors **SF3**	Math 7 **SF2**	Math 6/7 **SF1/2**
8th Grade **(Algebra Benchmark Grade)**	Algebra **MDA1/SF3 or a new text**	Algebra Honors **MDA1**	Pre-Algebra **SF3**	Math 7/8 **SF2**

9th Grade	Algebra/Geometry	Geometry Honors (**new class**) **MDG**	Algebra **MDA1**	Math Foundations
10th Grade	Geometry/Adv. Algebra	Adv. Algebra Honors (**new class**) **MDA2**	Geometry **MDG**	Math 1
11th Grade	Pre-Calculus	Pre-Calculus Honors	Adv. Algebra MDA2	Math 2
12th Grade	Statistics (**new elective class**)	Calculus I and II	Math elective	Applied Math (**new elective class**)

1.2.3. It is believed that student performance on the 10th grade math multiple choice and Problem Solving state assessments will improve by implementing the 8th grade algebra standard (see below).

1.2.4. Integrate mathematics into the other subjects, where practicable. Refer to Table 2 above.

1.2.5. The district should create a math club, or integrate it with the science club, which currently exists. Establishing a club that includes math topics will further excite students about mathematics. The following items should be considered:

1.2.5.1. A math club allows students to find their own niche and explore their own interests. It increases the potential for students to have fun exploring topics in mathematics. It can augment the activities of the honors math classes.

1.2.5.2. As a minimum, the club should meet at least once a month. Topics may include:

1.2.5.2.1. Presentations by students of math topics of interest

1.2.5.2.2. Speakers from inside and outside the district (teachers, graduate students, professionals in industry, etc.)

1.2.5.2.3. Establishing math competitions

1.2.5.2.4. Field trips to local/distant areas of mathematical interest

1.2.5.2.5. Other topics of interest may be explored at the organization titled Mu Alpha Theta, a national mathematics honorary organization with chapters all over the country (over 1,400 schools with 65,000 students represented). http://www.mualphatheta.org/

1.2.5.3. The club serves as an organizing mechanism to raise funds to send students to math competitions.

1.2.6. Provide additional career guidance opportunities for students. Provide more information about careers in science and engineering. Advertise among the student body the myriad of activities in the Portland metropolitan area, the state, and the nation, ranging from potential colleges and universities to job shadowing, and to professional scientific and engineering societies that have programs directly targeted to high school students.

1.2.6.1. One specific example of an opportunity to provide additional guidance along these lines is through the National Society of Professional Engineers (NSPE) "Engineers Week". Since 1951 this weeklong activity has provided thousands of students valuable opportunities and insight into the many fields of engineering. Engineers Week is usually held during the third week of February and is sponsored by over 100 engineering-related societies and major corporations. While the focus is on high school and college students, programs do exist for K-8 as well (see below). For more information, browse http://www.eweek.org.

1.2.6.2. Explore the free career guidance program created by MIT (Massachusetts Institute of Technology) and Microsoft to introduce engineering to high school students. This program is brought directly to each high school. To learn more, review http://www.eweek.org/site/media/mit-program.shtml.

1.3. Junior High

1.3.1. A goal should be set to make Algebra the subject the majority of students will successfully be able to master by the 8th grade (see Table 3 above). In order to accomplish this, the curriculum from kindergarten through the 8th grade must be aligned to meet this goal. The current Sadlier textbooks we are using should help to meet this goal, with selected augmentation as required (see recommendations below for K-6). Refer to Appendices B & F for additional information on this topic. Full implementation of this goal can be achieved by the beginning of the 2005-2006 school year. Proposed modifications to the 6th grade mathematics program have been developed by the Junior High (refer to Appendix C) in order to meet this goal. Furthermore, it is believed that no modifications to the current curriculum will need to be implemented below the 6th grade in order to achieve this goal.

The mathematics department at the Junior High will need to determine if a new text book is required for the Pathway 1 Algebra class. If so, a decision on the appropriate new text must be made by July 2004.

1.3.2. Due to the large number of students in the math classes, typically 30 or more over the past several years, consider adding an FTE, or a fraction of an FTE in mathematics to relieve the overcrowding. If funding limitations do not allow for this to occur, consider using math mentors, which could be students from the high school. A reasonable maximum class size for junior high students should not exceed 28.

1.3.3. In tandem with the high school, begin the honors track sequence with an Honors Algebra class. The honors class should follow the recommendations presented above for the high school geometry and advanced algebra classes. If students perform satisfactorily in this class, high school credit should be given.

1.3.4. It is believed that implementing goal 1.3.1, above, will raise student performance on the 8th grade math multiple choice state assessment.

1.3.5. Approximately three times per year, the mathematics teachers at the Junior High (or their designee) should visit with the appropriate teachers at the High School (for 9th grade math) and the elementary schools (for 6th grade math). The purpose of this is to provide time for discussions to ensure that a consistent scope and sequence is being achieved as well as to explore successful teaching methods in mathematics.

1.3.6. Integrate mathematics into the other subjects, where practicable. Refer to Table 2 above.

1.3.7. Consider creating a math club or math/science club at the junior high level. Refer to the High School, above, for additional recommendations. Consideration should be given to providing a stipend to the club advisor.

1.3.8. Adhere to the calculator usage policy, which is included in Appendix A.

1.3.9. Explore opportunities for middle school students to learn more about the many fields of science and engineering. One possibility includes the various programs surrounding Engineers Week, which is organized by the National Society of Professional Engineers. Such programs include: 1) A cooperative program with the PBS television show, ZOOM, 2) Introduce a Girl to Engineering Day, 3) Arranging to have an engineer/scientist visit the classroom to discuss opportunities. For more information, browse the information for K-12 students at http://www.eweek.org.

1.3.10. Procure the necessary manipulatives and the respective training that are part of the recently-purchased math text books.

1.3.11. Implement a test to determine the level of standing for all incoming 6th grade students. This test will be used in conjunction with the 6th grade teacher's recommendation of each student. (A pilot test will be conducted in May 2004.)

1.3.12. Create a "Study Hall" or similar dedicated period to provide students time to seek help from mentors or teachers in the subjects they need assistance with.

1.3.13. Teaching staff should consider the regular use of assessment devices to ensure adequate progress in learning is being made for each student. Refer to district policy for a list of recommendations.

1.4. Elementary Schools

1.4.1. Begin the acceleration of students that demonstrate greater ability in mathematics at the third grade level (refer to Table 3 above). This acceleration pathway can follow one of two options:

1.4.1.1. Option 1: For each grade level (3rd, 4th, 5th, and 6th) determine a similar number of students from each grade to be accelerated. A survey of a number of school districts in the metropolitan area indicates that about 15% - 20% of the students in a typical population will have the aptitude to succeed in this environment. Therefore, for each of these grade levels, determine the appropriate number of students that meet the aptitude criteria and place them in the succeeding year's math class. With this method, each teacher should receive an approximately equal number of students that are replacing the ones that are moving up to the next grade level, thus minimizing any change in teacher work load. For students in the 6th grade, additional instructional help may need to be retained to teach the 7th grade math class (one class per day). When the 6th graders from each elementary school reach the Junior High, they will constitute the necessary student population to fill out the honors mathematics pathway noted above. (**Preferred option**)

1.4.1.2. Option 2: For each grade level (3rd, 4th, 5th, and 6th) select the appropriate number of students from each grade as determined by student performance and/or teacher resource availability. For example, if an entire class of students is required for teacher allocation reasons, then up to 20 to 25 students per grade (in each elementary school) may be eligible. However, when these students reach the Junior High level, this number will need to be reduced through appropriate means to achieve the 15% - 20% required population for the honors classes.

1.4.2. In order to achieve the goal of having the majority of students (75% - 80%) be ready to successfully take algebra by the 8th grade, refer to Appendix C for modifications that should be implemented at the 6th grade level curriculum.

1.4.3. The Sadlier text requires some augmentation. Refer to the following table for recommendations by grade where the Sadlier text should be supplemented:

Table 4	
Sadlier Text Augmentation Recommendations	
Grade	Recommended items for Augmentation
K	Tubs of activities
1	Rote memorization/extra practice on facts, Math games, flashcards, Saxon fact sheets, 5-10 Calendar time each day covering week, month; counting to 100 different ways, place value to 100th.
2	There has been no carrying/borrowing, no foundation for ordinals, unclear problem solving, no revisiting of past concepts, pre-teaching for foundation, carrying, problem-

	solving.
3	Money unit, strands such as probability, geometry, and measurement not done with much depth, Timed fact tests, telling time and money, bridges, number corner
4	More problem solving,
5	Probability unit lacking in practice, in Geometry there's nothing on line segments. More work also needed on measuring angles, timed tests on facts; problem solving.
6	No recommendations provided.

1.4.4. Develop/continue to implement plans to improve scores on the state assessment tests in Math problem solving. Promote the participation of the K-6 teachers in scoring of the state assessments.

1.4.5. There exists quite a variance in student performance between schools, and on an annual basis within the same school, regarding the various mathematical content standards (algebra, geometry, statistics, etc.) as measured on the state assessment tests. Therefore, it is not possible to identify pervasive weaknesses that exist at each school, or among all three schools, regarding the content standards as currently measured. Other tools should be used to define these short comings (see item immediately below).

1.4.6. In order to address the observation of the Junior High mathematics department regarding incoming weaknesses of students, the elementary schools should address student shortcomings in the following areas:

1.4.6.1. fractions

1.4.6.2. division (whole numbers and decimals)

1.4.6.3. rates, ratios, and per cents

1.4.6.4. computation & estimation

1.4.6.5. number sense (a developed concept of what a reasonable answer should be), see item 1.4.7 below.

1.4.6.6. measurement (including units).

1.4.7. In order to address a student's weakness regarding number sense (see item 1.4.6.5, above), it is recommended that the school district research and potentially pilot the "Number Worlds" program at the Kindergarten level. Refer to Appendix D for further information about this program.

1.4.8. Provide professional development opportunities for teachers to ensure familiarity will all relevant NCTM recommendations.

1.4.9. Include the participation of K-6 teachers in the development of the scope and sequence of mathematics curriculum in order to better address the requirements of the TESA test. Incorporate this information into the overall K-12 curriculum.

1.4.10. Provide some time every year for teachers to communicate between each of the three elementary schools to ensure that a common scope and sequence is being achieved as well as to explore successful teaching methods in mathematics.

1.4.11. Refer to Table 2 above for recommendations to integrate mathematics into other subjects.

1.4.12. Adhere to the calculator usage policy, which is included in Appendix A.

1.4.13. The following approximate amount of time (minimum) should be allotted on a weekly basis to teach problem solving:

1.4.13.1. Kindergarten: Once a week (Up to 30 minutes per session)

1.4.13.2. First: Once a week (45 – 60 minutes per session)

1.4.13.3. Second: Once a week (45 – 60 minutes per session)

1.4.13.4. Third: Once a week (45 – 60 minutes per session)

1.4.13.5. Fourth: Once a week (45 – 60 minutes per session)

1.4.13.6. Fifth: Once a week (45 – 60 minutes per session)

1.4.13.7. Sixth: Once a week (45 – 60 minutes per session)

1.4.14. Math should be taught for about 30 minutes per day, every day, at the kindergarten level and about 60 minutes per day, every day, at the other grades.

1.4.15. Explore opportunities for elementary school students to learn more about the many fields of science and engineering. One possibility includes the various programs surrounding Engineers Week, which is organized by the National Society of Professional Engineers. Such programs include: 1) A cooperative program with the PBS television show, ZOOM, 2) Introduce a Girl to Engineering Day, 3) Arranging to have an engineer/scientist visit the classroom to discuss opportunities. For more information, browse the information for K-12 students at http://www.eweek.org.

1.4.16. Suggested supplemental reading for elementary school mathematics:

Measurement
Adler, David, How Tall, How Short
Yeatts, Karol, Cereal Math

Weights and Measures
Pallotta, Jerry, Hershey's Milk Chocolate Weights and Measures
Yeatts, Karol, Cereal Math

Number Sense
Daniels, Teri, Math Man
Pallota, Jerry, Underwater Counting: Even Numbers
Pinczes, Elinor, One Hundred Hungry Ants
Schwartz, David, On Beyond a Million (Powers of Ten)
Scieszka, Jon, Math Curse
Turner, Priscilla, Among the Odds and Evens

Counting
Koller, Jackie French, One Monkey Too Many
McGrath, Barbara Barbieri, The Cheerios Counting Book
Pallota, Jerry, Underwater Counting: Even Numbers
Yeatts, Karol, Cereal Math

Algebra
McGrath, Barbara Barbieri, The M&M's Color Pattern Book

For Grades K – 2 (in particular, but not limited to these grades)

Refer to Appendix E for a copy of the Math Correlation Index from a book titled Anytime Math: Read-Aloud Anthology, Harcourt Brace and Company. This book is full of poems and rhymes, songs, and stories; all of which can be used for math reinforcement.

Anticipated Timeline to Achieve the Recommendations

It is anticipated that all recommendations contained within this report can be met by the beginning of the 2005-2006 school year.

Anticipated Costs to Achieve the Recommendations

Very minimal costs will be incurred to implement this plan. The following items have been identified:

1. Due to overall crowding at the junior high, additional FTE (whole or fractional) should be considered at this school to meet the required needs as outlined in this report. This should be part of an overall plan at the Junior High to address this problem that exists across all subjects.
2. Funds will be needed to acquire additional Algebra textbooks for the junior High: budget $6500.00 for the 2004-2005 school year.
3. Funds should be budgeted to procure the textbooks for the two new classes at the High School as noted above: budget $6500.00 for the 2005-2006 school year.

Periodic Evaluation of the Plan by the School District

The purpose of evaluating the Mathematics Education Plan on a periodic basis is to monitor implementation, adjust to changing educational strategies and fiscal appropriations, and identify future needs.

It is the recommendation of this Sub-Task Force to have this plan reviewed by the school district on an annual basis.

The Curriculum & Special Services Director will report to the Board on an annual basis, after completing the assessment of the Plan, to inform the Board about the "State of Mathematics Education" within the district.

Appendix A

Calculator Usage Position Statement and Usage Policy

Estacada School District Calculator Usage
Position Statement and Usage Policy

Background

Handheld calculators have been in use worldwide for many years. When used properly, these devices provide many advantages to students in mathematics, science, and other classes where mathematics applications are employed. However, how and when they should be used in elementary and secondary education is still a subject of study and debate.

The NCTM Curriculum and Evaluation Standards urge the unrestricted use of calculators to reduce the time spent on pencil and paper methods of calculation so that students can have more time to work on problems that foster the development of underlying concepts. NCTM suggests that by using this approach, students develop a stronger basis for understanding how to approach complex problems. Meanwhile, educators and others who do not share this belief completely have expressed concern that young children (elementary level) in classrooms where calculators are heavily used may not develop proficiency with basic arithmetic operations. Results of the TIMSS surveys included questions for teachers and students on their level of calculator use in schools. A broad range of results was recorded, varying primarily between participating countries. For example, in Japan calculators are not permitted until grade 5. Other countries reported that the use of calculators in the lower grades is limited until students master basic computational skills, both mentally and by using pencil and paper. Lastly, in some countries, calculator use is unrestricted.

Although NCTM recommends integration of calculators into the school mathematics program at all levels, research on the effect of calculator use on achievement is not definitive.[1] While correlations can often be misleading without a direct cause and effect, the vast majority of 4^{th} grade students in the highest TIMSS-scoring nations (Japan, Singapore, and South Korea) report they never use calculators in math class. As a result of the lack of definitive and causative studies, many suggest that more extensive, high quality research be performed on the use of calculators at the elementary level.

[1] *Science and Engineering Indicators – 2002*, National Science Foundation, Division of Science Resources Statistics, Arlington, VA (NSB 02-01), April 2002.

Calculator Usage Philosophy Statement

The increasing capability of the calculator over previous tools (mental, pencil and paper, slide rule, etc.) has caused a switch in focus from the mechanics of the algorithm to its result. The students can concentrate on showing their understanding of the topic rather than their ability to perform a manual calculation. Students who are less proficient at mathematics and who often dislike the subject can benefit from the use of calculators.

A number of established priorities exist that cannot be compromised or minimized by the overuse, or otherwise improper use, of calculators. Students need to be taught that calculators do not replace the need for understanding what it is that is being calculated. Students must also realize that they cannot accept answers at face value without having a prior idea of what result may or may not be acceptable in the context of the question. Lastly, in the working world, a calculator is not always available when a calculation must be done; or frequently, an answer can be arrived at much more quickly by mental calculation alone. As a result, a firm basis for traditional methods of calculation must be developed and mastered at an early age, prior to delving into the many benefits that a calculator has to offer.

K-6

1. Due to the lack of high quality research in the area of appropriate calculator usage at the elementary level, its use should be limited to allow ample opportunity to gain proficiency in basic arithmetic operations utilizing both pencil and paper and mental methods. Calculator usage must be minimized in order that the understanding of basic mathematical operations is fully acquired and never lost.
2. Where calculators are used, they should be limited to the four function or most basic variety.
3. Basic skills which are required to be mastered at this level cannot depend upon calculators. Students must have ample opportunities to practice pencil and paper and mental techniques by designating most lessons, or large portions of lessons, “calculator free”.
4. Students can be taught to use calculators, where properly introduced, by encouraging estimation, perhaps by having them record their estimate before performing the calculator-based calculation. Students should also be taught that calculations should always be checked in a different order or by a different method.
5. Selected mathematical explorations could be well complemented by the use of calculators or computers to display, or enhance, a particular topic. Examples include the use of graphics to display curves or solids or other geometric patterns.

7-12

1. Calculators are not merely devices to carry out calculations. They should be used to enhance understanding of mathematics concepts, carry out creative mathematical explorations, develop mathematical intuition, and facilitate the acquisition of general number sense.
2. Calculators may be broadly classified into four main categories:
    a. Four function, or basic,
    b. Scientific,
    c. Scientific with graphing capability,
    d. Computer-based spread sheets

   Recommendations concerning the calculator type required for a particular grade level or class must consider both economic factors and the appropriate knowledge base required for the class (what is to be mastered in the particular class and will the use of a particular calculator type either help or hinder the student).
3. Calculator approximation skills (the principles of significant figures and rounding) should be taught side-by-side with mental estimation skills. As a corollary of this statement, students must learn to appreciate the nature and beauty of irrational or transcendental numbers, which can be lost with the improper use of calculators.
4. Generally, calculator methods should not replace traditional methods of problem solving. Rather, they should reinforce these methods and enhance student’s understanding of these methods. Calculators should facilitate the “rule of four” approach to problem solving: graphical, numerical, algebraic, and verbal.
5. Calculator exercises should be incorporated into the appropriate homework, quiz, and examination questions of each course with an emphasis on interpretations of results rather than merely developing competence with technology.
6. Assigned work and examinations should assess a student’s calculation skills and critical thinking ability both with and without calculator or computer technology.
7. Calculators should not be used to assist in the solution of algebraic or trigonometric problems until the student has completely mastered the fundamentals of symbolic algebraic manipulation and the basic definitions of trigonometric functions. In calculus classes, students should not be

allowed to utilize calculators to perform integration or differentiation studies until the students have mastered the basic methods to perform these operations and learned other, more traditional methods to perform these operations.

Calculator Usage Policy

K-6

The use of four-function or basic calculators shall be restricted and used for only the following applications:

1. Checking of work that was completed previously by pencil and paper or mental means,
2. Selected exploration (investigation) activities,
3. In a controlled setting for performing more difficult calculations that are not typical in a given section or homework set,
4. As allowed on state assessments.

7-12

The use of calculators (type and extent) shall be at the discretion of each school and its math department (Junior High and High School). The district's philosophy regarding the use of calculators shall be incorporated into the decisions made. The level of calculator use permitted on tests shall be no greater than the calculator use specified for a particular course.

Students with Specific Learning Disabilities (K-12)

Calculator usage will depend upon the recommendations contained within each student's IEP Plan.

Appendix B

Should Algebra be Taught in 8th grade for the Majority of Students?

Should Algebra be Taught in 8th Grade for the Majority of Students?

Submitted by: Frank Franklin

Research does show that the teaching of algebra has a positive effect on academics, higher achievement in high school and a lower drop out rate. This higher achievement does happen across ethnicity as well as in all social economic status.

Oregon State Standards as well as the NCTM does introduce algebra in the 8th grade. The standard now includes items that were part of CIM requirement.

How do we do this based on research?

1. Students will need extra help and extra time if they are to succeed. This extra time/help has to be in a study hall atmosphere and monitored by an experienced teen or an adult /teacher.
2. Students must have advisory teachers who assist in setting up educational goals and plans for high school. Teachers must teach organizational skills as well as creating a direct line of communication between parents and school.
3. Students must have better preparation in arithmetic. The change in Oregon State Standards has shifted from 9th grade to 8th grade. This means the elementary schools must attain their new standards. Elementary schools have to shift up to prepare their students.
4. Class size and class time? Junior high or middle schools have to have a different structure than the self contained classrooms (elementary) and the larger sized high school classes. We have to realize that large class size (over 28 students) and longer class time (above 45 minutes) actually lowers the ability of students to retain taught material. Junior high students are not adults and not children, they are adolescents. We have been told that “chunking” is important. At the middle school level, 2 or 3 “chunks” of material in one class sitting is about all the average student can handle. If given more, students tend to not remember. In the Portland Metro area, I contacted 15 middle/junior high schools and did not find any whose class time exceeded 50 minutes. There does not seem to be any favorable research of longer class sessions in middle schools. The only exception is that block classes do work for science when used in conjunction with science lab. Several schools have been creative in ways to extend class time to facilitate a science lab period.
5. Middle school students need to have some incentive to take classes. They do not always want to learn just for the sake of learning. We need to offer a “carrot” for them. This could be a half credit towards high school requirements. Algebra is a requirement for college, why not for high school? We could also offer electives that the students could have fun at. Some possible electives could be: model building, square dancing, childcare, 1st aid, rocket launching, newspaper, math or science labs.
6. This is a pet peeve. I believe the middle school students should have a required period of reading. They should be required to read 7 or 8 books per year (depending on context) and keep a log of what they have read. They should be quizzed about the books they have read. We now incorporate reading into the language arts program. I feel reading time should be a requirement throughout the district at all levels.

In conclusion:

Research has shown that teaching algebra in the 8^{th} grade has an overall positive affect in academics and behavior. Research has also shown that to teach algebra and be successful, one must also implement the following:

1. Extra time and help to succeed (study hall, etc.)
2. Must link student with an adult mentor/teacher
3. Students must implement an educational plan and also a high school plan
4. Class length and class size have a negative effect when they approach a certain number. There is a reason (and it isn't because of union demands) that there are states in the U.S.A. that limit class size in core classes.
5. Reading should be required in middle school/junior high school. The statistics show us that the more students read, the more likely they are to succeed.
6. We may need to offer more electives at the middle school level to keep all students excited about attending school.

Where do we go from here?

1. I can rewrite this report with notations to various research if the committee requests.
2. If we plan to teach algebra in middle school, we need to decide on the parameters we will use. Do we teach an entire year in the 8^{th} grade for the majority of the students? Will we teach college prep algebra to the TAG students? Or do we teach college prep geometry to the TAG students? These classes would have to match the overall plan for math in the Estacada School District.
3. If we plan to teach algebra, and we decide on a curriculum, we must then decide on what material we are going to use and what goals we need to attain.
4. Last, but the most important: Each teacher must decide on a commitment to cover the material required by the district for their grade level(s).

Appendix C

Suggested Modifications to the 6th, 7th, and 8th Grade Mathematics Curricula

Appendix D

***Number Worlds* Information**

Appendix E

Math Correlation Index

Appendix F

Selected Excerpts from "Mathematics Framework for California Public Schools"