Secondary Mathematics:
Curriculum, Resources and Pathways

June 18, 2018
Our Vision: A Cohesive K-12 Math Experience for All Students

NMUSD Math Adoption Timeline

- 2016-2017, K-5
- 2017-2018, 6-8
- 2018-2019, Pilot Math I
Unit of Change: Our Sites


- An Adoption Process: Alignment & Deepening Content Knowledge
- Taking Inventory of our NMUSD K-12 math System
  - Connecting K-12 Decisions
  - Working with Dr. Patrick Callahan
Our Essential Questions!

1. What secondary mathematics curricula and resources best support students success in secondary mathematics?

2. While still providing access to the highest levels of math currently offered (AP Calculus), what mathematics pathway options should be available to all students to support success and college and career readiness for all students?
Four Points

1. Shifts in expectations in mathematics from college and career
2. Common Core standards are different -- math class is not the same as it used to be (focus, rigor, coherence)
3. Middle school is critical mathematics (why acceleration is better in HS)
4. Pathways can have the exact same endpoints, no students are being denied higher level mathematics options (AP Calculus, etc) that were previously available.
Commitment to Meet the Expectations of our Standards

- Our K-8 Math Standards tell a coherent story in preparation for high school.
- Focus, Coherence and Rigor: balanced, connected and deeper understanding.
- All K-8 content is the foundation for high school mathematics success.
Highest Rated Materials in 6-8 Classrooms

Focus and Coherence

Rigor and Mathematical Practices

Usability
Correct Answer versus Grade Level Explanation

- Correct Answer
- Grade Level Explanation

% of students

Grade Level

6 7 8 9 10
While still providing access to the highest levels of math currently offered (AP Calculus), what mathematics pathway options should be available to all students to support success and college and career readiness for all students?
1. 7th Grade: Offer Math 7 for all 7th grade students  
   a. Schools run intervention support classes as an elective supplemental course

2. 8th Grade: Offer Math 8 for all 8th grade students  
   a. 2018-19 only: Math I for students who completed Enhanced Math 7 / 8 in 2017-18  
   b. Schools run intervention support classes as an elective supplemental course

3. 9th Grade: Math I for all students.  
   a. Schools run intervention support classes as an elective supplemental course

4. Math HS Pathways to be determined next year; discussion TBD
Possible Road to Calculus: What it Can Look Like
The NMUSD Adoption Committee has spent the past year and a half doing careful research and analysis to develop a thorough set of recommendations regarding secondary curriculum, instruction, pathway and placement policies.

The Committee has reached out to get support and advice from many outside experts. Dr. Callahan has worked with the Committee to provide in-person facilitation during the process.

He will share a few key points that emerged over the course of the Committee’s work.
Four Points

1. Shifts in expectations in mathematics from college and career
2. Common Core standards are different -- math class is not the same as it used to be (focus, rigor, coherence)
3. Middle school is critical mathematics (why acceleration is better in HS)
4. New proposed pathways have the exact same endpoints, no students are being denied higher level mathematics options (AP Calculus, etc) that were previously available.
1. Shifts in expectations

Careers and Colleges are looking for different skills, knowledge and use of mathematics from students.
## Fortune 500: Most valued skills

<table>
<thead>
<tr>
<th>1970</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Writing</td>
<td>Teamwork</td>
</tr>
<tr>
<td>2 Computational Skills</td>
<td>Problem Solving</td>
</tr>
<tr>
<td>3 Reading Skills</td>
<td>Interpersonal Skills</td>
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<tr>
<td>4 Oral Communications</td>
<td>Oral Communications</td>
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<tr>
<td>5 Listening Skills</td>
<td>Listening Skills</td>
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<tr>
<td>6 Personal Career Development</td>
<td>Personal Career Development</td>
</tr>
<tr>
<td>7 Creative Thinking</td>
<td>Creative Thinking</td>
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<tr>
<td>8 Leadership</td>
<td>Leadership</td>
</tr>
<tr>
<td>9 Goal Setting / Motivation</td>
<td>Goal Setting / Motivation</td>
</tr>
<tr>
<td>10 Teamwork</td>
<td>Writing</td>
</tr>
</tbody>
</table>
2015 World Economic Forum: Top Skills

Top 10 skills

<table>
<thead>
<tr>
<th>in 2020</th>
<th>in 2015</th>
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</thead>
<tbody>
<tr>
<td>1. Complex Problem Solving</td>
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</tr>
<tr>
<td>2. Critical Thinking</td>
<td>2. Coordinating with Others</td>
</tr>
<tr>
<td>3. Creativity</td>
<td>3. People Management</td>
</tr>
<tr>
<td>4. People Management</td>
<td>4. Critical Thinking</td>
</tr>
<tr>
<td>5. Coordinating with Others</td>
<td>5. Negotiation</td>
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<tr>
<td>6. Emotional Intelligence</td>
<td>6. Quality Control</td>
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<tr>
<td>7. Judgment and Decision Making</td>
<td>7. Service Orientation</td>
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The Future of Jobs

Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution
### Competencies

1. Master core academic content
2. Think critically and solve complex problems
3. Work collaboratively
4. Communicate effectively
5. Learn how to learn
6. Develop academic mindsets
2. Shifts in standards

The Common Core State Standards were adopted by CA in 2010

*They were a response to what colleges and careers were asking from K-12 schools.* There was a two step process:

1) Survey many fields, universities, and businesses: “What mathematics should a high school graduate know and be able to use?”. Synthesize the responses into a definition of “College and Career Readiness”

2) Reverse engineer from these HS graduate expectations to create a **focused, coherent, and rigorous** set of standards grades K-11
Common Core defines rigor as a balance...

3) **Rigor**: Pursue conceptual understanding, procedural skills and fluency, and application with equal intensity

Rigor refers to deep, authentic command of mathematical concepts, not making math harder or introducing topics at earlier grades. To help students meet the standards, educators will need to pursue, with equal intensity, three aspects of rigor in the major work of each grade: conceptual understanding, procedural skills and fluency, and application.

“Not making math harder or introducing topics at earlier grades”
Rigor in Mathematics

COMMON CORE MATHEMATICS

Defines rigor as procedural fluency, conceptual understanding, and applications in equal intensity.
The new SAT exam

It’s About the Real World

Instead of testing you on every math topic there is, the new SAT asks you to use the math that you’ll rely on most in all sorts of situations. Questions on the Math Test are designed to mirror the problem solving and modeling you’ll do in:

- College math, science, and social science courses
- The jobs that you hold
- Your personal life

For instance, to answer some questions you’ll need to use several steps—because in the real world a single calculation is rarely enough to get the job done.

What the Math Test Measures

Fluency

The Math Test is a chance to show that you:

- Carry out procedures flexibly, accurately, efficiently, and strategically.
- Solve problems quickly by identifying and using the most efficient solution approaches. This might involve solving a problem by inspection, finding a shortcut, or reorganizing the information you’ve been given.

Conceptual Understanding

You’ll demonstrate your grasp of math concepts, operations, and relations. For instance, you might be asked to make connections between properties of linear equations, their graphs, and the contexts they represent.

Applications

These real-world problems ask you to analyze a situation, determine the essential elements required to solve the problem, represent the problem mathematically, and carry out a solution.
A typical image taken of the surface of Mars by a camera is 11.2 gigabits in size. A tracking station on Earth can receive data from the spacecraft at a data rate of 3 megabits per second for a maximum of 11 hours each day. If 1 gigabit equals 1,024 megabits, what is the maximum number of typical images that the tracking station could receive from the camera each day?
The recommended daily calcium intake for a 20-year-old is 1,000 milligrams (mg). One cup of milk contains 299 mg of calcium and one cup of juice contains 261 mg of calcium. Which of the following inequalities represents the possible number of cups of milk $m$ and cups of juice $j$ a 20-year-old could drink in a day to meet or exceed the recommended daily calcium intake from these drinks alone?

Select an Answer

- A $299m + 261j \geq 1,000$
- B $299m + 261j > 1,000$
- C $\frac{299}{m} + \frac{261}{j} \geq 1,000$
- D $\frac{299}{m} + \frac{261}{j} > 1,000$
The scatterplot above shows counts of Florida manatees, a type of sea mammal, from 1991 to 2011. Based on the line of best fit to the data shown, which of the following values is closest to the average yearly increase in the number of manatees?

Options:
A) 300
B) 500
C) 1000
D) 1500
E) 2000
Old expectations (CA STAR test)
More emphasis on procedural, routine, decontextualized items.
Less focus on sense making, complex problem solving, and concepts.

Which is one of the solutions to the equation \(2x^2 - x - 4 = 0\)?

A. \(\frac{1}{4} - \sqrt{33}\)

B. \(-\frac{1}{4} + \sqrt{33}\)

C. \(\frac{1 + \sqrt{33}}{4}\)

D. \(-\frac{1 - \sqrt{33}}{4}\)

\[(4x^2 - 2x + 8) - (x^2 + 3x - 2) = \]

A. \(3x^2 + x + 6\)

B. \(3x^2 + x + 10\)

C. \(3x^2 - 5x + 6\)

D. \(3x^2 - 5x + 10\)
Contrast old STAR test to new SAT items (on the same topic but different expectations)

The toll rates for crossing a bridge are $6.50 for a car and $10 for a truck. During a two-hour period, a total of 187 cars and trucks crossed the bridge, and the total collected in tolls was $1,338. Solving which of the following systems of equations yields the number of cars, x, and the number of trucks, y, that crossed the bridge during the two hours?

Which ordered pair is the solution to the system of equations below?

\[
\begin{align*}
    x + 3y &= 7 \\
    x + 2y &= 10
\end{align*}
\]

A \( \left( \frac{7}{2}, \frac{13}{4} \right) \)  
B \( \left( \frac{7}{2}, \frac{17}{5} \right) \)  
C \(-2, 3\)  
D \((16, -3)\)
3. Significant shifts in Middle School

The Common Core puts the **MOST USEFUL** mathematics topics and tools in middle school.

Proportional reasoning, decimals, percentages, functions, data, geometry
Math in context

**Home Decorators Collection**
Bays Mountain - Color Scout Texture 12 ft. Carpet

**Price after Savings**: $628.52

**TrafficMASTER**
Thoroughbred II - Color Indy Texture 12 ft. Carpet

**Price after Savings**: $9.00 /square yard
Why accelerate in HS instead of MS?
Why did we accelerate or skip MS math?

We were trying to solve the problem of students not being sufficiently challenged in MS math.

Previous standards were significantly more procedural in MS. Speed and accuracy are salient components of procedural fluency. Some students were faster and hence not challenged. The solution the CA adopted was to move advanced math courses for HS and put them into MS and skip or accelerate through the old MS courses.
There is another solution

If MS math is not challenging for some students, they can skip ahead to HS math.

OR

Change the mathematics taught in MS to make it more rigorous and challenging. This is what the Common Core did.
Grade 8 Math covers important topics. Many of which were HS topics.
4. End goals: higher level math options

Before the Common Core in CA there was a standard sequence of courses:

Algebra 1, Geometry, Algebra 2, Pre-Calculus, Calculus

If a student wanted access to Calculus, they had to somehow fit five years of courses into four years of high school.

This coupled with the fact that the previous MS was not challenging for some students led to the policy of Algebra 1 in Grade 8.
The shift is less about “topics covered” and more about what students do with them:

<table>
<thead>
<tr>
<th>Previous expectations</th>
<th>Current expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Set up the mathematics</td>
<td>1) Set up the mathematics</td>
</tr>
<tr>
<td>2) Do the computations</td>
<td>2) Do the computations</td>
</tr>
<tr>
<td>3) Interpret the results</td>
<td>3) Interpret the results</td>
</tr>
<tr>
<td>4) Communicate the results</td>
<td>4) Communicate the results</td>
</tr>
</tbody>
</table>
ALSO: You do not need to accelerate to access and succeed in AP Calc or AP Stats

IMPORTANT: The Common Core is more rigorous than previous standards. A student who is successful in a high quality Math 1, 2, 3 sequence in Grades 9-11 would be well prepared to take AP Calculus or AP Statistics 

*without any acceleration.*
The upshot

Shifts in expectations from Careers and Colleges
Shifts in standards and assessments
Lead to new curriculum and instruction
And new policies and pathways
To better serve all students, regardless of their goals.