### 6-8 Math Curriculum Adoption

MAY, 2023

# Board Workshop - May 2, 2023

On Tuesday, May 2, we provided a lengthy presentation outlining the learning, collaboration within the field of mathematics, curriculum pilot process, and research that guided the recommendation that is outlined on the slides ahead.

All community members are welcome to review the full presentation housed on our TSD Math website.

### 6-8 Curriculum Review Process: 2019-2023



### District Data Review

Program data overtime (MSTEP)

Cohort data (student performance overtime)

Student choice & tracking data

#### 6th Grade MSTEP Data Over Time





Started in         I         2019-2020         2021-2022         2021-2022         2022-2023           • Math 5         896         826         833         856           Algebra 1 Honors         1         1         1           Math 6         496         416         479         4900           Math 6/7 Honors         385         389         343         356           Math 7/8 Honors         7         9         3         9           Math 5         3         9         7         1           • Math 6         526         511         409         519           Math 7/8 Honors         16         34         19         29           Math 7/8 Honors         16         34         19         29           Ø Math 6/7 Honors         426         405         404         344           Algebra 1 Honors         1         2         1         344           Algebra 1 Honors         360         356         376         322           Ø Math 7/8 Honors         10         39         11         15           Geometry Honors         10         39         11         15           Geometry Honors <t< th=""><th>STUDENT MATH PATH Following Year</th><th>· 💌</th><th></th><th></th><th></th></t<>	STUDENT MATH PATH Following Year	· 💌			
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#### % of Students by Test and Performance Level

### Our Vision for Mathematics



All students are doers of mathematics. We believe the purpose of our mathematics program is to cultivate students' positive mathematical identities so that all students:

- develop deep mathematical understandings
- •understand and critique the world through mathematics
- experience the wonder, joy, and beauty of mathematics

NCTM (2020). Catalyzing Change in Middle School Mathematics

# Findings

Finding 1: Explore curricular changes

- Program data from the last 5 years preceding COVID revealed:
  - Student performance was slightly decreasing or stagnant (program data)
  - Cohort data showed a decrease in the number of students who achieved at advanced and proficient and an increase in students who were not proficient

### Finding 2: Explore course sequencing

• Students are not able to fluidly move between tracks in middle school

### Finding 3: Explore classroom pedagogy

• Explore task-based, inquiry-based, instruction that builds procedural fluency through conceptual understanding

#### Middle School Math Curriculum Review Matrix

	Blue		Red		Gold		Green
\$ \$ \$ \$	How does the curriculum present students with the opportunity to engage in Deep Learning? How does the curriculum allow for student discussion and talk? How is the curriculum inquiry and/or task based? How are topics cohesively sequenced in a storyline or learning arc that is engaging to students? How does curriculum support students in engaging in the standards for mathematical practice?	\$ \$ \$ \$	How does the curriculum value students' mathematical ideas? How does the curriculum invite all students in? How does the curriculum provide choice and voice for students? How does the curriculum elicit joy? How does the curriculum allow for opportunities for differentiation?	\$ \$ \$ \$ \$ \$	How does the curriculum support teachers in using the 8 effective math practices? What professional learning is offered? How is it structured? Who runs it? How are teachers supported in on-going professional learning? How does the curriculum support teachers in differentiation? How is the curriculum connected to a research base or connected to a learning organization (university etc.)?	§	How does the curriculum support students in future pathways? How is the curriculum relevant to students' lives and college and career interests?
E	<i>v</i> idence:	Ev	idence:	E٧	vidence:	Εv	idence:

### Review Rubric

### Pilot Process

Team investigated 8 different curricula, narrowed down to two using review matrix

50% of our middle school math teachers participated in the pilot

Representation from each course participated in the pilot (Math 6, Math 6/7 Honors, Math 7, Math 7/8 Honors, Math 8)

All four middle schools participated

Structure of Pilot

- Semester 1, Connected Mathematics Project (CMP)
- Semester 2, Illustrative Mathematics (IM)

Scope of the Pilot

• Two or more units of each curriculum (CMP and IM) were taught by all teachers in the pilot

### Recommendation: Illustrative Math

- Problem-based
- Universal design for learning
- Embedded supports for:
  - students with disabilities
  - English learners



- Extensions for students who are ready for more
- Built-in Instructional routines that support teachers and students
- Activity and lesson structure is predictable and purposeful
- Practice problem sets with built-in cumulative review



7



7. Kate is looking for a frosting with the strongest red color. She finds three different recipes

using red food coloring and white frosting.

#### Which recipe has the strongest red color?

Recipe A 3 drops food coloring 5 ounces frosting	Recipe B 12 drops food coloring 15 ounces frosting	Recipe C 1 drops food coloring 3 ounces frosting
02108 3 6 9 12 15 Rook 9 5 10 15 20 25 Rook 9 8 16 24 32 40	Wer 12 24 Fresh 5 80 Tahai 27 Ed	6 1 2 3 4 5 1 2 3 4 5 1 2 5
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 Kate is looking for a frosting with the <u>strongest red color</u>. She finds three different recipes using red food coloring and white frosting.

#### Which recipe has the strongest red color?



 Explain and/ or show how you got your answer in question 7. On Schoology, you can type your answer or take a picture of your reasoning/work.

At one point they all had 15 ounces of frosting. So I circled the 15 in all the recipes and above It, B had the most food coloring for 15. So I knew since it was the most amount that would have the strongest taste.



 Kate is looking for a frosting with the <u>strongest red color</u>. She finds three different recipes using red food coloring and white frosting.

#### Which recipe has the strongest red color?

(Recipe B) Recipe C Recipe A 12 drops food coloring 1 drops food coloring 3 drops food coloring 3 ounces frosting 5 ounces frosting 15 ounces frosting 0 000 000000 000 00000 00000 3 5 5 5 3.5 15 8. Explain and/ or show how you got your answer in question 7. On Schoology, you can type your answer or take a picture of your reasoning/work. Recipe & because if you campare the Numbers to fractions (ecife Bis large mand is mare reasonable





### Example Lesson: Math 8

#### Learning goals:

- Describe (orally and in writing) how exponent rules extend to expressions involving negative exponents.
- Describe patterns in repeated multiplication and division with 10 and  $\frac{1}{10}$ , and justify (orally and in writing) that  $10^{-n} = \frac{1}{10^n}$ .

#### Learning goals (student facing):

• Let's see what happens when exponents are negative.

#### Learning targets (student facing):

- I can use the exponent rules with negative exponents.
- I know what it means if 10 is raised to a negative power.

#### **Cool Down Guidance:**

**Points to emphasize:** If students struggle with negative exponents in the cool-down, plan to revisit negative exponents when opportunities arise over the next several lessons. For example, in Lesson 6, Activity 2: What happens with zero and negative exponents, make sure to invite multiple students to share their thinking negative exponents focusing on question 5.

Every Cool Down is coded for teachers as, More Chances, Points Emphasize, and Press Pause.

### Example Lesson: Math 8

### Warm-up:

Solve each equation mentally.

 $\frac{100}{1} = 10^x$  $\frac{100}{r} = 10^1$  $\frac{x}{100} = 10^0$  $\frac{100}{1,000} = 10^x$ What patterns did you see? How would you continue those patterns for the last problem?



2. How does a multiplier of 10 affect the placement of the decimal in the product? How does the other multiplier affect the placement of the decimal in the product?

3. Use the patterns you found in the table to write  $10^{-7}$  as a fraction.

4. Use the patterns you found in the table to write  $10^{-5}$  as a decimal.

5. Write  $\frac{1}{100.000,000}$  using a single exponent.

multiplier as you move right?

6. Use the patterns in the table to write  $10^{-n}$  as a fraction.



- 10-minute activity
- Students work independently for 5-7 minutes
- Teacher uses the Collect and Display routine to stabilize the varied language in use during mathematical work, in order for students' own output to become a reference in developing mathematical language.
- Not all students will finish all parts of this activity!
- Whole group discussion -"Did anyone think of this a different way?" "In your own words, what does  $10^{-7}$  mean? How is it different from 10<sup>7</sup>?"

### Example Lesson: Math 8

#### 5.3: Follow the Exponent Rules

1. a. Match each exponential expression with an equivalent multiplication expression:



 $\frac{10^2}{10^5}$ 

 $\frac{10^2}{10^{-5}}$ 

 $\frac{10^{-2}}{10^5}$ 

 $\frac{10^{-2}}{10^{-5}}$ 



b. Write  $(10^2)^{-3}$  as a power of 10 with a single exponent. Be prepared to explain your reasoning.

- a. Match each exponential expression with an equivalent multiplication expression:
- It is important for students to ٠ understand that the exponent rules work even with negative exponents.

to share what they disagreed

about and how they came to an

20-minute activity

discussion.

agreement.

students

٠

Students work in pairs for 15

Discussion supports for all

Select students who had

minutes. 5-minute whole group

disagreements during the activity

- Make a clear connection between • the exponent rules and the process of multiplying repeated factors that are 10 and  $\frac{1}{10}$ .
- Contrast the expanded version ٠ of  $(10^{-2})^3$  and  $(10^2)^{-3}$



expression:

 $10^4 \cdot 10^3$ 

 $10^4 \cdot 10^{-3}$ 

 $10^{-4} \cdot 10^{3}$ 

3.

(10	$(\cdot 10 \cdot 10 \cdot 10) \cdot (\frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10})$
$\left(\frac{1}{10}\right)$	$\cdot \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10}  ight) \cdot \left( \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} \right)$
$\left(\frac{1}{10}\right)$	$\cdot \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} \right) \cdot (10 \cdot 10 \cdot 10)$
(10	$\cdot 10 \cdot 10 \cdot 10) \cdot (10 \cdot 10 \cdot 10)$

b. Write  $10^{-4} \cdot 10^3$  as a power of 10 with a single exponent. Be prepared to explain

a. Match each exponential expression with an equivalent multiplication



10.10

10.10

b. Write  $\frac{10^{-2}}{10^{5}}$  as a power of 10 with a single exponent. Be prepared to explain your reasoning.

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# Example Lesson: Math 8



#### Are you ready for more?

Priya, Jada, Han, and Diego stand in a circle and take turns playing a game.

Priya says, SAFE. Jada, standing to Priya's left, says, OUT and leaves the circle. Han is next: he says, SAFE. Then Diego says, OUT and leaves the circle. At this point, only Priya and Han are left. They continue to alternate. Priya says, SAFE. Han says, OUT and leaves the circle. Priya is the only person left, so she is the winner.

Priya says, "I knew I'd be the only one left, since I went first."

1. Record this game on paper a few times with different numbers of players. Does the person who starts always win?

2. Try to find as many numbers as you can where the person who starts always wins. What patterns do you notice?

- This extensions has students explore patterns to discover a rule
- The rule can be defined using an exponent that isn't base 10
- This rule also requires students to write a number in an equivalent form using exponents

### Sample SAT Problem

The recommended daily calcium intake for a 20-year-old person 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 person could drink in a day to meet or exceed the recommended daily calcium intake from these drinks alone?

- A)  $299m + 261j \ge 1,000$
- B) 299*m* + 261*j* > 1,000

C) 
$$\frac{299}{m} + \frac{261}{j} \ge 1,000$$
  
D)  $\frac{299}{m} + \frac{261}{j} \ge 1,000$ 

### Sample AP Exam Question

Sample Questions

AP Calculus AB/BC Exam

4. An ice sculpture in the form of a sphere melts in such a way that it maintains its spherical shape. The volume of the sphere is decreasing at a constant rate of  $2\pi$  cubic meters per hour. At what rate, in square meters per hour, is the surface area of the sphere decreasing at the moment when the radius is 5 meters? (Note: For a sphere of radius *r*, the surface area is  $4\pi r^2$  and the volume is  $\frac{4}{3}\pi r^3$ .)

(A) 
$$\frac{4\pi}{5}$$

(B) 40π

(C)  $80\pi^2$ 

(D) 100π

### Middle School Pathways





### Choosing Math 8 or Honors Algebra 1

- •Math 8 is a natural transition from a Math 7 experience. Students will explore ideas of linearity, functions, and geometry and establish a solid foundation for future work in Algebra 1 and Geometry.
- •Honors Algebra 1 will embed Math 8 standards into Algebra 1. Students will move to formalizing and generalizing their understandings with a focus on efficiency and mastery.
- •In the spring of 7<sup>th</sup> grade, buildings will host information nights to discuss and illustrate the differences in Math 8 and Honors Algebra 1 to help families make informed decisions
- In the spring of 7<sup>th</sup> grade, families will engage with math teachers to discuss individual student needs- student performance in the following areas should be considered: problem solving skills, communication of mathematical thinking and ideas, math assessment feedback, standardized test scores, etc.

# Community Concerns

### 1. The proposed change in structure in mathematics seems to devalue mathematics and removes recognition from my student.

 TSD has a deep history of and commitment to excellence. Our recommended changes in mathematics will provide students with access to a rich curriculum and a solid foundation of mathematical skills. The opportunity for students to begin an honors pathway in mathematics moves to 8<sup>th</sup> grade with the selection of Honors Algebra I.

#### 2. The change in classroom learning may not motivate my student to excel.

• The IM curriculum provides teachers with the resources to meet the needs of students, teachers will be collaborating beginning this spring to build their skills on how they will engage and continue to develop students' passions in mathematics. Our teachers are passionate about challenging our students in math!

#### 3. My student may not be prepared to be successful in advanced and AP level mathematics.

 Student preparation for advanced and AP level mathematics should be as strong or stronger with the implementation of the new IM curriculum.

#### 4. The change in course title will impact student GPA.

• Honors classes are not weighted in the Troy School District GPA. Middle school courses are not included in student transcripts for college admissions.

# Math 8 and Algebra 1 Standards Alignment

#### Comparison of Algebra 1 and Math 8 Standards:

Algebra 1 Standards	Math 8 Standards	Analysis
A-CED Create equations that describe numbers or <u>relationships</u> "Create equations and inequalities in one variable and use them to solve problems."	8.EE Analyze and solve linear <u>equations</u> <i>"Solve linear equations in one variable"</i>	In Math 8 students are solving only linear equations In Algebra 1 students are solving both linear equations and inequalities.
A-REI Reasoning with equations and Inequalities "Solve systems of equations"	8.EE Analyze and solve linear equations and pairs of simultaneous <u>linear</u> equations. <i>"Solve systems of two linear equations"</i>	In Math 8 the focus is the solution to a linear system of equations is the intersection of the linear equations, specifically representing this graphically. Students also solve systems algebraically. In Algebra 1 students prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the <u>other</u> produces a system with the same solutions.
A-SSE Seeing Structure in expressions	Not addressed in Math 8	

# Summary on Crosswalk of Standards

All Math 8 standards are embedded into Algebra I standards with the exception of the Geometry Strand.

We anticipate that Honors Algebra I will need to spend approximately 4-5 weeks of instructional time to embed standards from Math 8 into Honors Algebra 1 in addition to providing the Algebra I curriculum.

Our school year has approximately 180 school days, as an example, the IM Algebra 1 curriculum has proposed 140 lessons (including assessments) which leaves 40 days (or 8 weeks) of time for us to embed Math 8 standards as needed.

# Supporting All Students

### **Advancement and Acceleration**

- •Deep levels of learning
  - Investing in staff through professional learning
- •Enrichment materials
  - Embedded within Illustrative Math ("Are You Ready for More?")
- •Enrichment and enhancement opportunities
  - Math club, robotics, etc

### •Traditional test-out opportunities to move more quickly through grade levels

### Implementation Plan

Spring 2023

• Two full day meetings with Math 6, Math 7 and Math 8 teachers

Summer Institute: August 8-11

2023/24 School Year:

- Back-to-school professional learning days
- Monthly job-embedded professional learning experience per grade level team
- Monthly afterschool PLC meetings with after school pay
- Full day of learning during January district professional learning
- Full time Math Specialist in each build to unpack units, co-plan, co-teach, and coach teachers and do intervention with struggling students

# Support for Families 2023/24

Parent learning sessions at buildings - with math teachers, math specialists and CIS

Parent learning sessions from experts in field

Classroom video examples - shared on our website

Every IM unit includes a section called *Family Support Materials*, which describes in plain language the big ideas students will encounter. These resources provide an overview of the mathematics students are learning, detail what to expect as the learning deepens, and include questions that promote conversation about the mathematics.

Every IM lesson includes a *lesson summary* and is written to help summarize the main mathematical points of a lesson, including any new vocabulary, in student-friendly language. They are meant for students to read on their own time, or perhaps to read to help catch up on a day they were absent. They are also useful for families who want to understand in more detail what their student is learning.

# Monitoring our Success

Goals:

- 1. See growth in the number of students who score advanced or proficient on the MSTEP Math Assessment, PSAT and SAT Exams.
- 2. Increase enrollment in and successful completion of Honors Algebra 1 in 8<sup>th</sup> grade as measured through enrollment data and end of course summative exams.
- 3. Build student problem solving skills and communication of mathematical thinking as monitored through internal common assessment.

Measurement of student achievement may include:

- Reported annually
  - MSTEP/PSAT/SAT including cohort data
  - Math benchmark assessments
- Studied with staff
  - Unit assessments and common assessments
  - Student enrollment in Algebra 1
  - Student success (grades) in higher levels of mathematics

# Thank you!