Please have a seat at the content level you are *most familiar*.

Coaching teacher teams through the process of Vertical Articulation: Secondary Mathematics

Let’s get Vertical!

Coaching teacher teams through the process of Vertical Articulation : Secondary Mathematics

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Round Table

Please Introduce yourself to your table members.

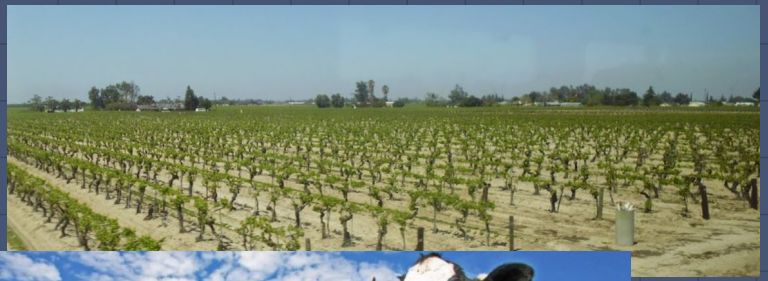
Share the State, County, School and Grade Level you teach, support, coach

Please Stand Up!
If you are a...

- A Teacher
- An Instructional Coach or Teacher on Special Assignment
- An Administrator

Central Valley of California

Examples



Non-Examples

About VUSD...

- Large suburban school district in the Central Valley of California
  - 12 Secondary Schools
  - 3 Alternative Education Schools
  - 26 Elementary Schools
  - 3000 Employees
  - 29,000 students
  - 14.4% English Language Learners
  - 62.1% Free/Reduced Lunch

Visalia UNIFIED SCHOOL DISTRICT

Today's Objectives

We will:

- Discuss various activities involving *vertical articulation.*
- Participate in one Vertical Articulation Activity.
- Develop Next steps for your district.

What is Vertical Articulation?

Whip Around

Efforts to improve the understanding of the progression of mathematics across grade levels in order to improve coherence.

Different Types of Professional Development

Lead Teachers only

- All Day PDs
- Mini PDs delivered within Curriculum Development Meetings
- District Office

ALL Teachers

- Led by Lead Teachers
- During PLC time
- On Site

Today's Focus will be the work we have done with our...

Lead Teachers only

- 3 All Day PDs
- At our District Office

Our ‘guides’ as we planned for Lead Teacher Teams

- Progression Documents
- Our Mathematics Vision
- CA CCSS-M Frameworks
- Big Ideas of each grade level
- “REAL” Priority standards

Progression Documents.

http://ime.math.arizona.edu/progressions/

- Draft High School Progression on Statistics and Probability
- Draft High School Progression on Algebra
- Draft High School Progression on Functions
- Draft High School Progression on Modeling
- Draft 7–HS Progression on Geometry
- Draft High School Progression on Quantity

Visalia Unified School District

Vision for... *Mathematics*

The VUSD math program will surpass expectations in student learning as a result of collaboration, goal setting and the implementation of the Standards for Mathematical Practices.

C - Collaborative Culture
L - Learning is Visible
A - Access and Equity
S - Student Centered
S - Standards for Mathematical Practices

What Students Learn in Mathematics I

Students in Mathematics I continue their work with expressions and modeling and analysis of situation In previous grade levels, students informally defined, evaluated, and compared functions, using them to model relationships between quantities. In Mathematics I, students learn function notation and develop the concepts of *domain* and *range*. Students move beyond viewing functions as processes that take inputs and yield outputs and begin to view functions as objects that can be combined with operations (e.g., finding $(f+g)(x)=f(x)+g(x)$). They explore many examples of functions, including sequences. They interpret functions that are represented graphically, numerically, symbolically, and verbally, translating between representations and understanding the limitations of various representations. They work with functions given by graphs and tables, keeping in mind that these representation are likely to be approximate and incomplete, depending upon the context. Students' work includes functions that can be described or approximated by formulas, as well as those that cannot. When func tions describe relationships between quantities arising from a context, students reason with the units i which those quantities are measured. Students build on and informally extend their understanding of integer exponents to consider exponential functions. They compare and contrast linear and exponenti functions, distinguishing between additive and multiplicative change. They also interpret arithmetic sequences as linear functions and geometric sequences as exponential functions.

Students who are prepared for Mathematics I have learned to solve linear equations in one variable and have applied graphical and algebraic methods to analyze and solve systems of linear equations in two variables. Mathematics I builds on these earlier experiences by asking students to analyze and

"Big Ideas"

Developed by the Lead Teachers on Day 1 of Vertical Articulation.

Based on ideas from the California State frameworks

Math 1

Algebraic Manipulation

- Rearranging and collecting terms
- Factoring and canceling common factors in rational expressions
- Properties of Exponents
- *Model and analyze situations by interpreting expressions and create equations

Understand Functions

- Function Notation
- Domain and Range
- Interpret and Translate between representations
- Compare linear (arithmetic) and exponential (geometric sequences)

Congruence based on rigid motion.

- Definition of Congruence
- Triangle congruence
- Formal Constructions

Applications of Pythagorean Theorem

- In the regular coordinate system
- Verify geometric relationships including
  - special triangles and quadrilaterals
  - Slopes of parallel and perpendicular lines.

Statistics and Probability

- Compare two data distributions and differences between populations
- Drawing Inferences from random sampling to create data sets.

Priority standards should be...

R.E.A.L.

R: Readiness Standard

Do students need this skill for the next level of instruction level or as a foundation for the next grade?

E: Enduring Standard

Does this standard appear at multiple grade levels?

A: Assessed (CAASPP, SAT)

Is the standard assessed as a major or additional/supporting standard?

L: Leverage Standard

Does this standard provide knowledge and skills that are valuable in multiple disciplines?

Planning For Day 1

What aha's do we want teachers to have?

How should Teachers be grouped?

Planning For Day 1

We wanted our teachers to:

- Have a better understanding of their grade level content.
- To better understand how our assessments aligned to our BIg Ideas.
- To recognize that connectedness between each grade levels' Big Ideas

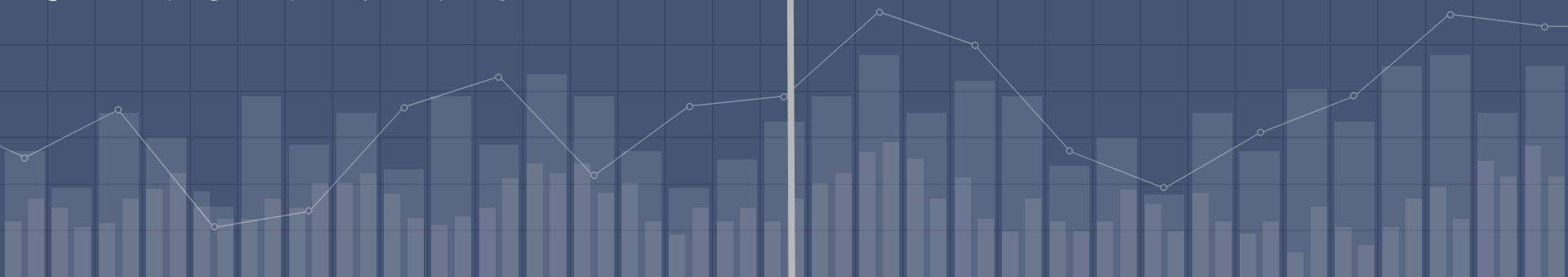
All Day PD for Leads
The Teams

Horizontal Teams

1. Grade 7
2. Grade 8
3. 8th grade Integrated Math 1
4. 9th grade Integrated Math 1
5. Integrated Math 2
6. Integrated Math 3

Vertical Teams

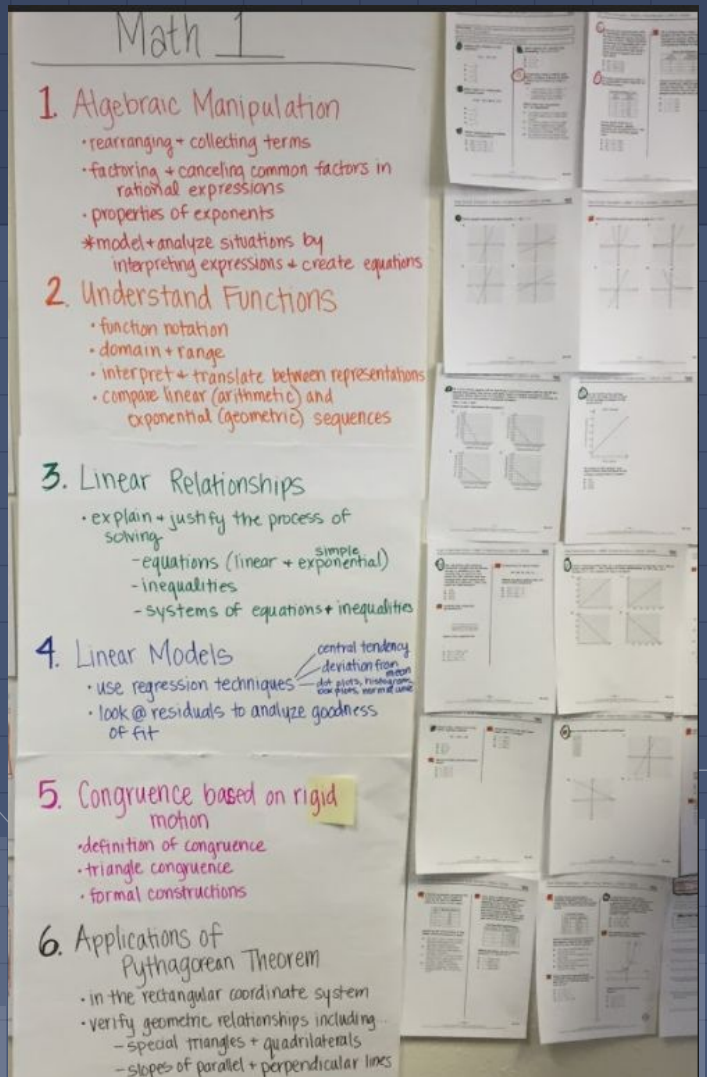
1. Green: Grade 7→ Math 3
2. Blue: Grade 7→ Math 3
3. Gold: Grade 7→ Math 3
4. Red: Grade 7→ Math 3



All Day PD for Leads
The Product

Day 1 Developing our Big Ideas:

- Teachers read standards frameworks section "*What students Learn in Math __.*"
- Postered their color coded Big Ideas of each Grade Level
- Aligned Final Assessment items with Big Ideas using color coding.



3	Vertical Teams GWHS-VO-Breanne RHS-GA-Cassie EDHS-LJ-Laurie MWHS, Divis- Debbie	***Math 3*** begins: Our standard is A.APR____ which is _____describe standard_____. We solve this problem by **Solution Pathway.** Students need to know **Learning Progression** before learning this standard. ***Math 2***: We support Math 3's standard by teaching standard ___. We solve this problem by **Solution Pathway.** Students need to know **Learning Progression** before learning this standard. Math 1, Math 8 and Math 7 follow, respectively, using Math 2's frame.	Algebra Problem from each vertical team and Note-taking Guide Poster: Give each team blank copy of problems. Teams poster student friendly language for vertical learning progression.	To make vertical learning progressions visible.
4	Vertical Teams GWHS-VO-Breanne RHS-GA-Cassie EDHS-LJ-Laurie MWHS, Divis- Debbie? Phil?	Repeat Steps 2,3 for: a. Functions b. Geometry c. Statistics	Vertical Problems template for Algebra--grade level specific. Algebra Problem from each vertical team and Note-taking Guide Give each team blank copy of problems. Teams poster student friendly language for vertical learning progression.	To • Continue to deepen connections between grade levels • relate our Big Ideas to our daily lessons

Day 2 continued

- Used color coded team documents to create Big Ideas and color coded assessments

6 Linda sets an appointment with an electrician who is charging a flat fee of $80 for parts plus $55 per hour of labor. Which of these represents an inequality she can use to solve for the number of hours the electrician can work if Linda wants to spend no more than $325?

A. $80x + 55 \geq 325$
B. $55x + 80 \leq 325$
C. $55x + 80 \geq 325$
D. $80x + 55 \leq 325$

7 The table shows how the cost of an automobile repair depends on the time it takes.

Automobile Repair Costs

Time (hours)	Cost (dollars)
1	85
2	145
3	205
4	265

8 At a school dance, there were 2 people on the dance floor when the music started. After that the number of people dancing increased as shown in the table.

Dance Participation

Time (minutes)	Number of People Dancing
0	2
1	6
2	18
3	54

Assume that the pattern in the table continues. Which equation can be solved for t, the time in minutes when the number of people dancing will reach 200?

A. $2 \cdot \frac{3}{t} = 200$
B. $2 \cdot 3t = 200$
C. $2 \cdot t^3 = 200$
D. $2 \cdot 3^t = 200$

Math 1

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- Factoring and canceling common factors in rational expressions
- Properties of Exponents
- *Model and analyze situations by interpreting expressions and create equations

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- Compare two data distributions and differences between populations
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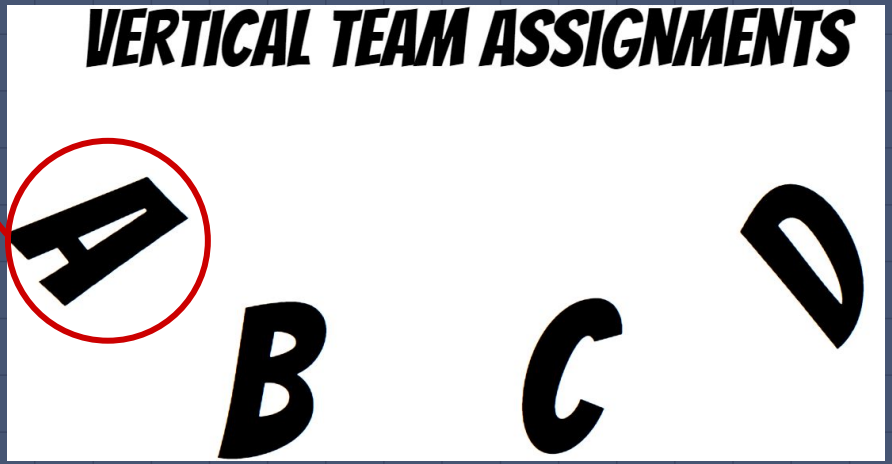
Day 2 cont'd: Vertical Articulation Activity

Horizontal Teams

1. Solve one problem from four domains.
2. Describe Solution Pathway for each problem.
3. Describe the learning progression for each problem.

Let's Do This!

Please move into Vertical Teams



VERTICAL TEAM A

Vertical Articulation Activity

Vertical Teams

1. Vertically align problems on poster paper.
2. Write Learning Targets for each assessment item to demonstrate the learning progression from grade 7 through Integrated Math 3
3. Record on note taking guide how one grade level supports the next.

Gallery Walk

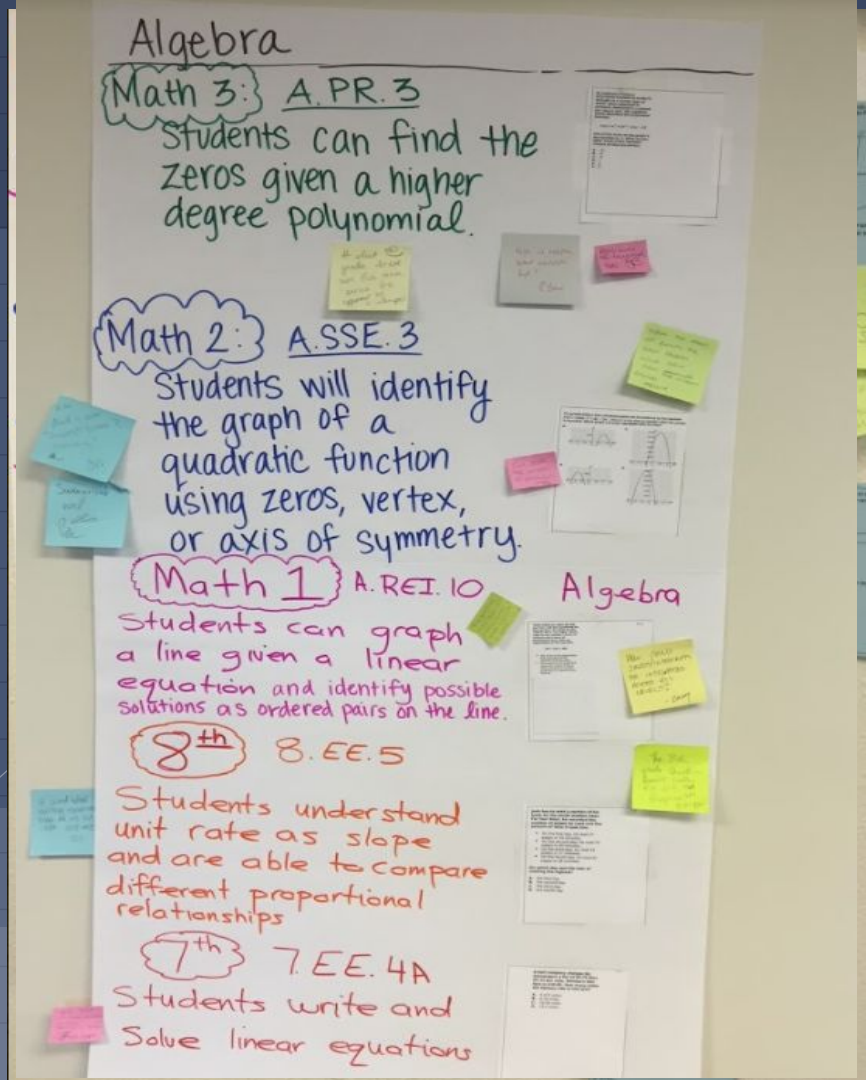
As a group, begin visiting posters.

Leave feedback on posters using sticky notes.

Feedback can be questions, comments or even “a-ha’s”

End of Day Two
The Product

- Student Friendly Learning targets for each domain.
- Gallery Walk and Post its revealed further questions and comments for consideration



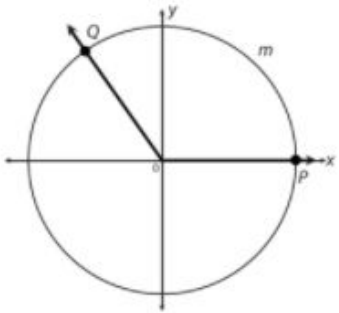
Th

Math 2

Math 3

Category: (F.TF.) Trigonometric Functions
Cluster: Extend the domain of trigonometric functions using the unit circle.
Standard:

In the unit circle below, the arc between points *P* and *Q* has length *m*.

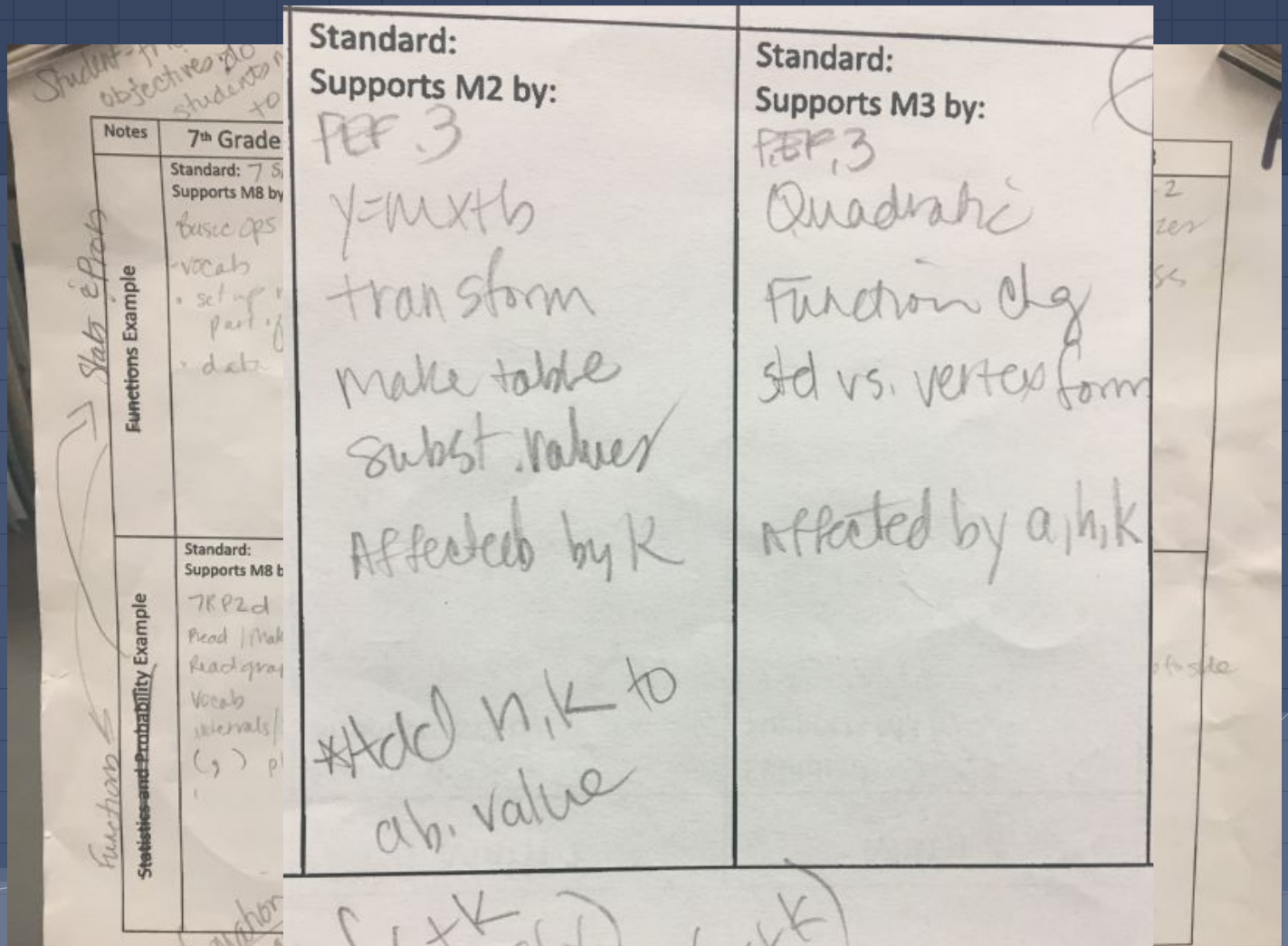


If the coordinates of point *Q* are $\left(-\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$, then what is the value of tan(*m*) ?

A. $-\sqrt{3}$
B. $-\frac{\sqrt{3}}{3}$
C. $-\frac{1}{2}$
D. $\frac{\sqrt{3}}{3}$

Solution Pathway

Learning Progression

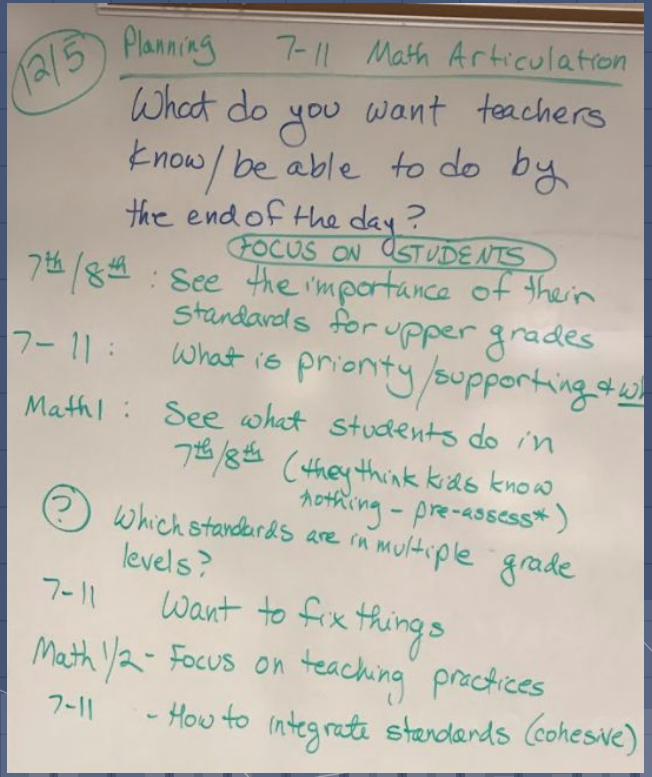


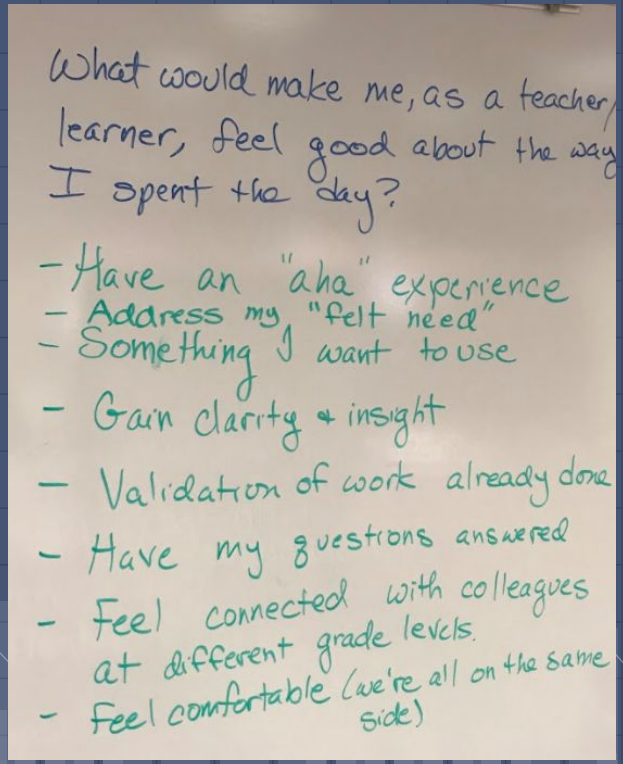
Notes	7th Grade
Functions Example	Standard: 7 S Supports M8 by Basic ops -vocab • set up part. f • data
Statistics and Probability Example	Standard: Supports M8 b 7RP2d Read | Mak Read grap Vocab intervals/ (,) p

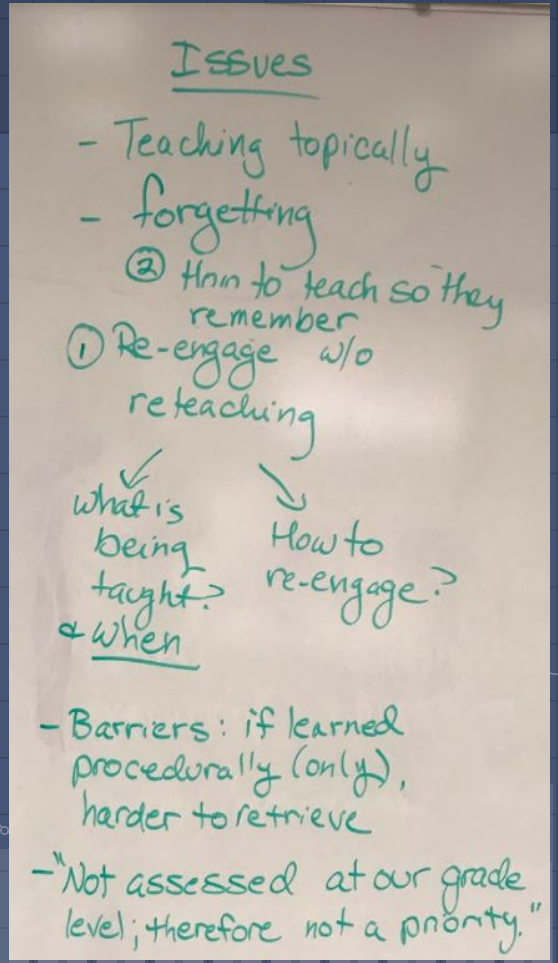
Standard:
Supports M2 by:
PEP 3
y=mx+b
transform
make table
subst. values
Affected by K
#Add n,k to
ab. value

Standard:
Supports M3 by:
PEP, 3
Quadratic
Function dg
std vs. vertex form
Affected by a,h,k

Day 3: Planning







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Day 3: Process

Horizontal Teams

- Sort Standards into Big Ideas
- REAL: Prioritize standards
- Cluster remaining standards under each priority

Day 3: Process

Horizontal Teams

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- REAL: Prioritize standards
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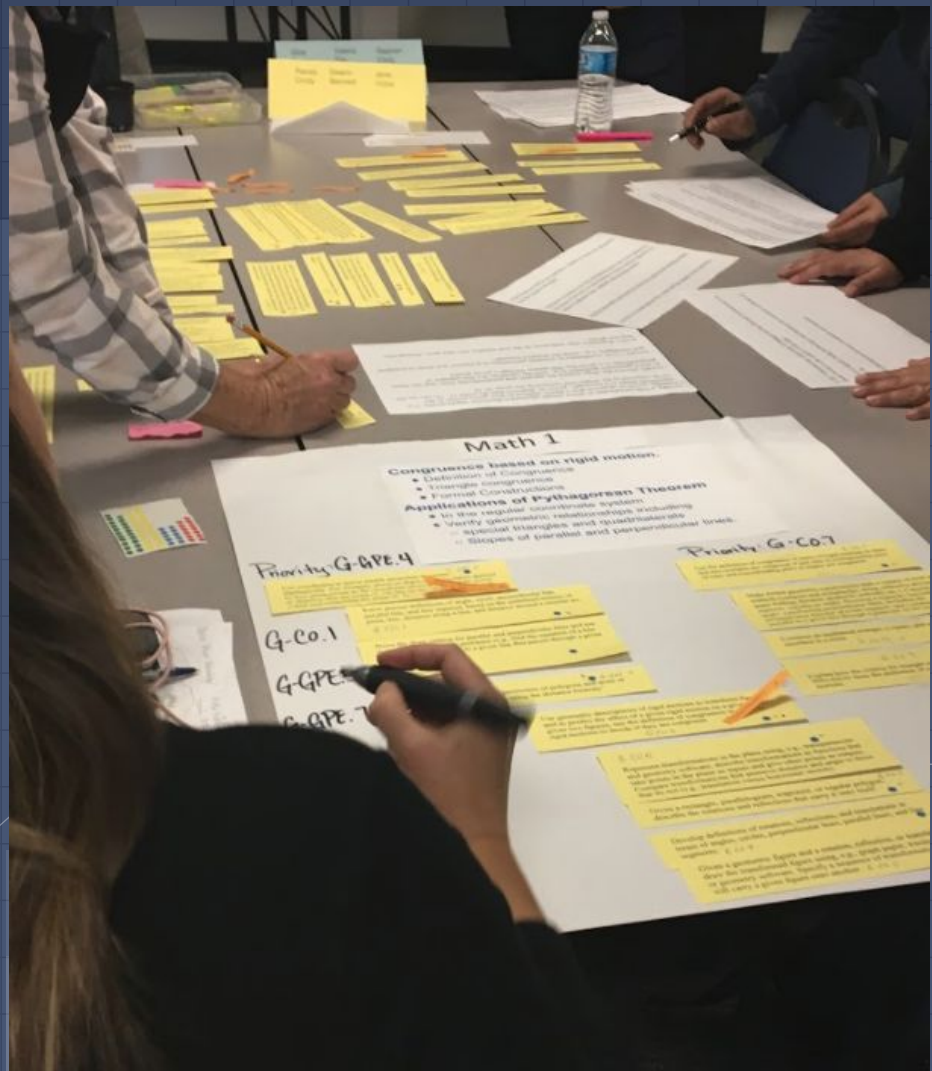
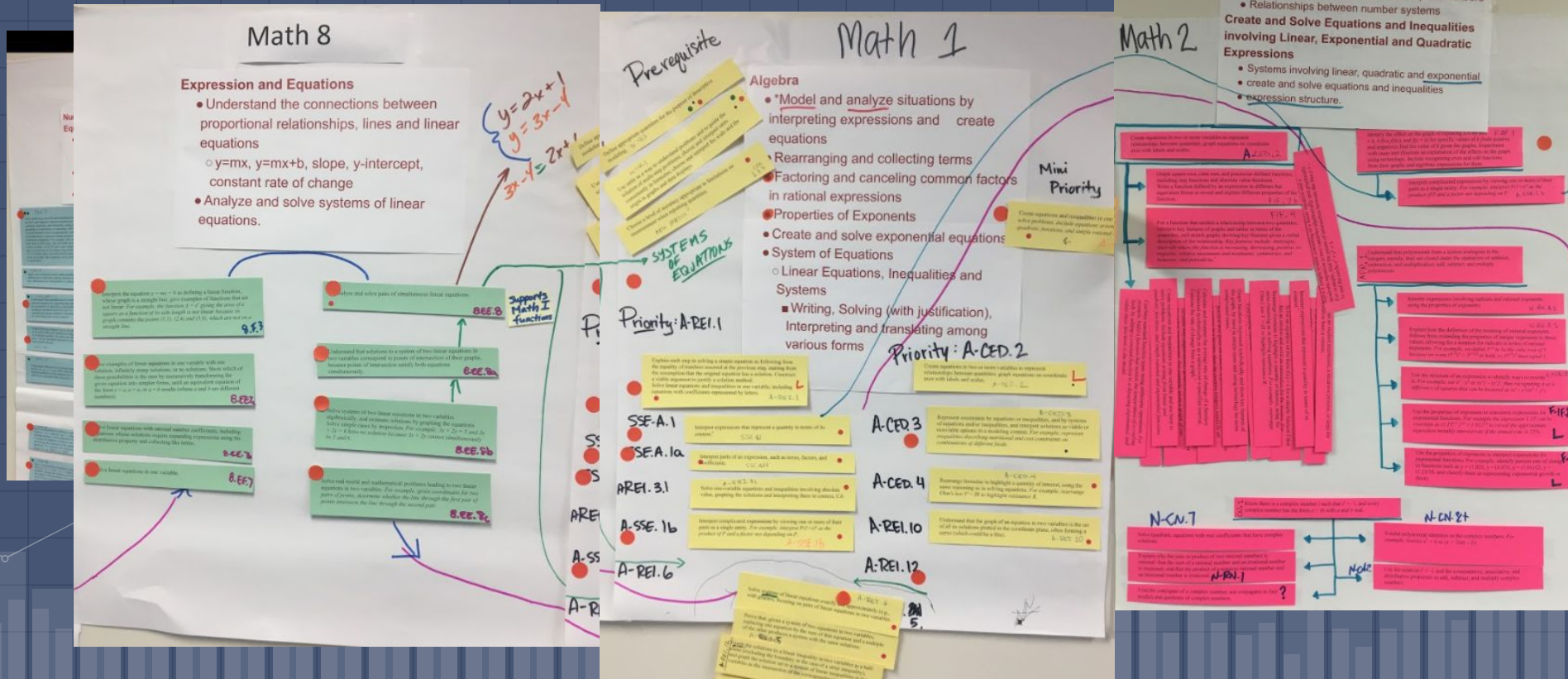
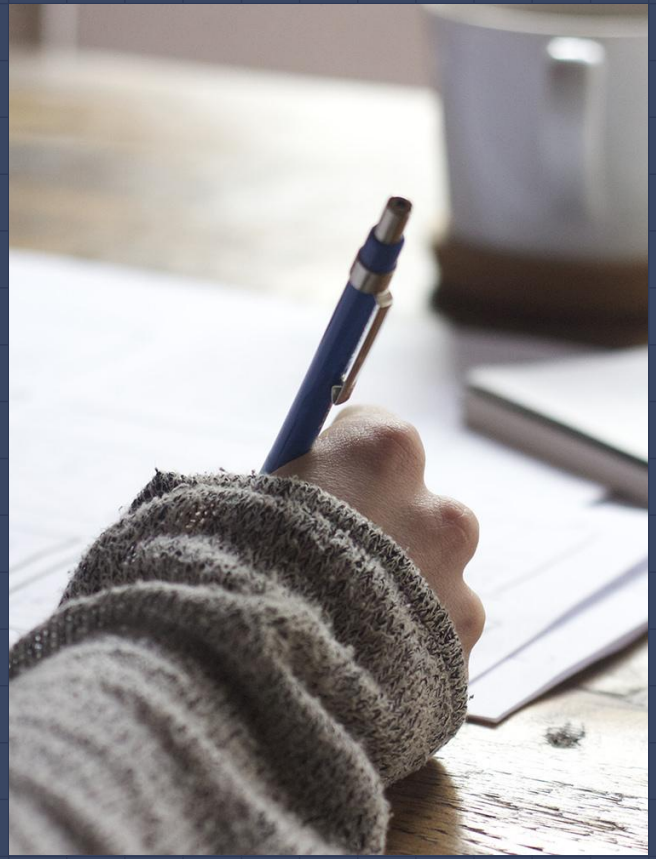



Math 8
Expression and Equations
• Understand the connections between proportional relationships, lines and linear equations
○ y=mx, y=mx+b, slope, y-intercept, constant rate of change
• Analyze and solve systems of linear equations.
y=2x+1
y=3x-4
3x-4=2x+1
8.F.3
8.EE.2
8.EE.7
8.EE.7b
8.EE.8
8.EE.8a
8.EE.8b
8.EE.8c
Supports Math 1 functions
Prerequisite
Math 1
Algebra
• *Model and analyze situations by interpreting expressions and create equations
• Rearranging and collecting terms
• Factoring and canceling common factors in rational expressions
• Properties of Exponents
• Create and solve exponential equations
• System of Equations
○ Linear Equations, Inequalities and Systems
■ Writing, Solving (with justification), Interpreting and translating among various forms
Mini Priority
SYSTEMS OF EQUATIONS
Priority: A-REI.1
Priority: A-CED.2
SSE-A.1
SSE.A.1a
AREI.3.1
A-SSE.1b
A-REI.6
A-CED.3
A-CED.4
A-REI.10
A:REI.12
Math 2
Extend Laws of Exponents
• Extend solution sets to include complex numbers
• Relationships between number systems
Create and Solve Equations and Inequalities involving Linear, Exponential and Quadratic Expressions
• Systems involving linear, quadratic and exponential
• create and solve equations and inequalities
• expression structure.
N-CN.7
N-CN.8+
N-RN.1
N-CN.2

Next Steps

What will you do to ensure that your teacher teams continue to learn about the progression of mathematics across grade levels?

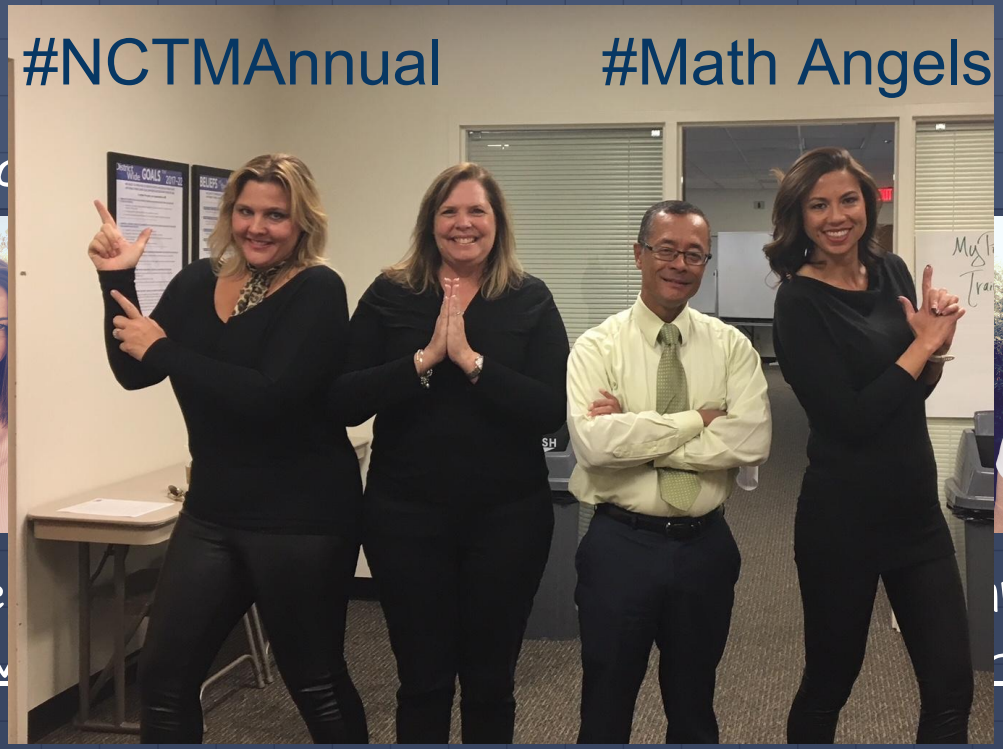


We are Visalia Unified.
We educate kids.
We create futures.

#OTOM
One Team One Mission

#NCTMAnnual #Math Angels

Stay Co



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