Structuring Mathematical Tasks to Engage Students in Productive Struggle

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Introductions

Introduce yourself to the people at your table (name, district, role, interesting fact).

Discuss:

How do you currently support your students when they struggle?

Think about . . .

What is your current definition of productive struggle?

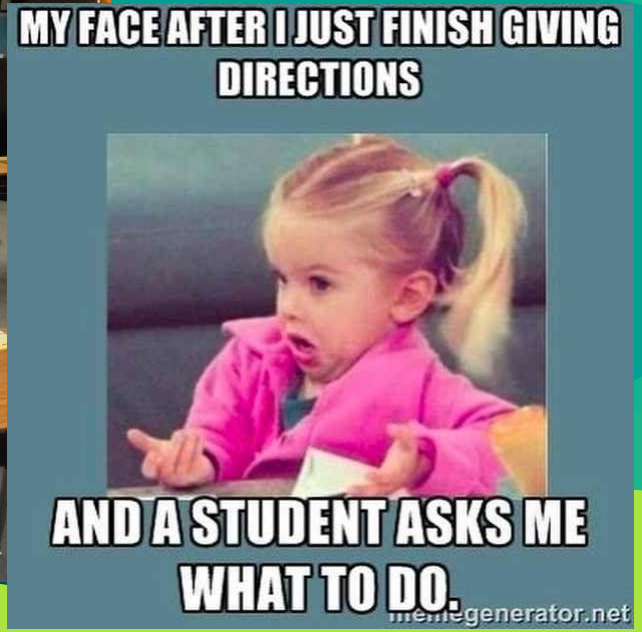
Please write down your current definition on your handout.

Session Outcomes

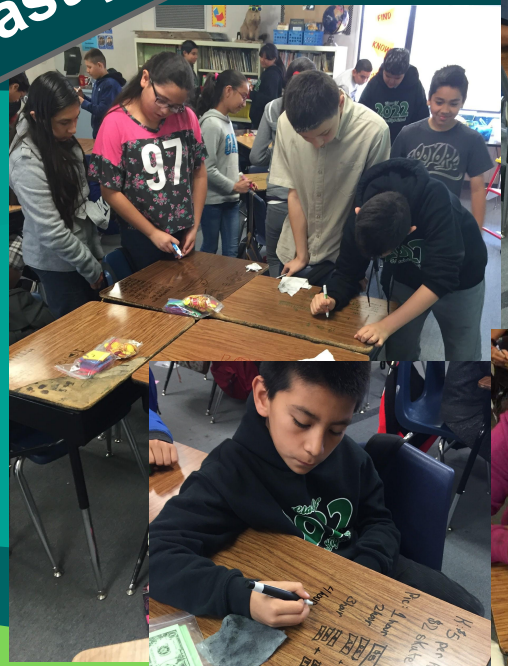
- Learn ways to create a culture that supports productive struggle.
- Develop strategies to help students build perseverance as they makes sense of and solve problems.
- Explore ways to select and structure tasks to engage students in productive struggle.

My Very First Classroom

2010-2011

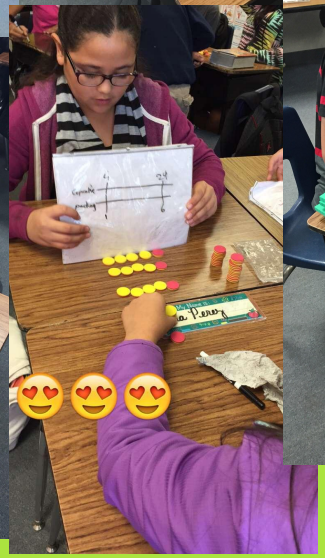


Last year


97


CHAMPIONS!


GO JEFFERSON!
I will learn something new today.
FIGHT ON!
FIGHT ON!
GO JETS
I will always be a good example.
Today's Number
Word Form
Expanded Form
Digits
Number Line
Make 10
Double & Lime
Equal Groups
Tape + Algae Mats
Classroom Rules



Productive Struggle

What we know…

- Problem solving is at the heart of mathematics.
- Struggle is critical in the learning process.
- Students must talk to learn.

What we should do…

- Support students in becoming problem solvers.
- Provide opportunities for struggle.
- Support students in having conversations about their thinking.

What is productive struggle?

How does our view of struggle impact our instruction?

“Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.”

NCTM’s Principles to Actions: Ensuring Mathematical Success for All p. 48

Creating a Classroom Culture to Support Productive Struggle

Fostering student understanding, growth mindsets, and student ownership

Creating a Classroom that Supports Productive Struggle

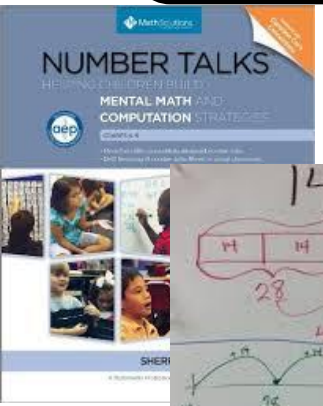
Opening Up Mathematics

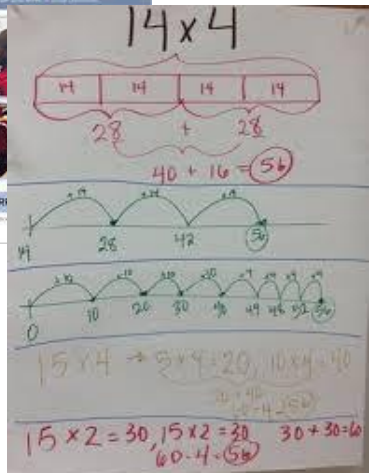
Foster student understanding

- Number Routines
- Manipulatives
- Visual Math

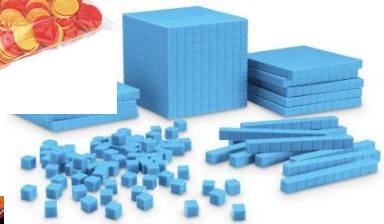
How can we make math accessible again?

Number Routines

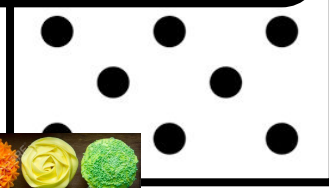




Manipulatives



Visual Math



Creating a Classroom that Supports Productive Struggle

Teacher Steps

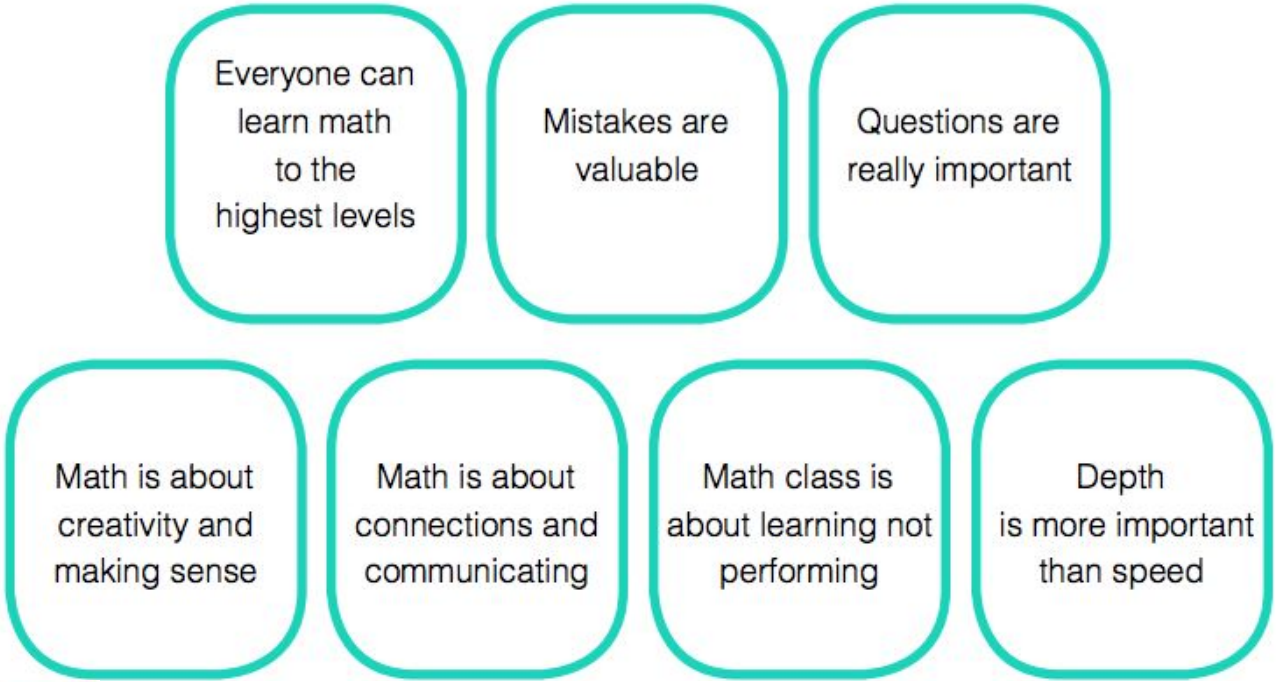
Foster growth mindsets

Messaging

Feedback

Norms & Expectations

Classroom Norms



youcubed
at Stanford University

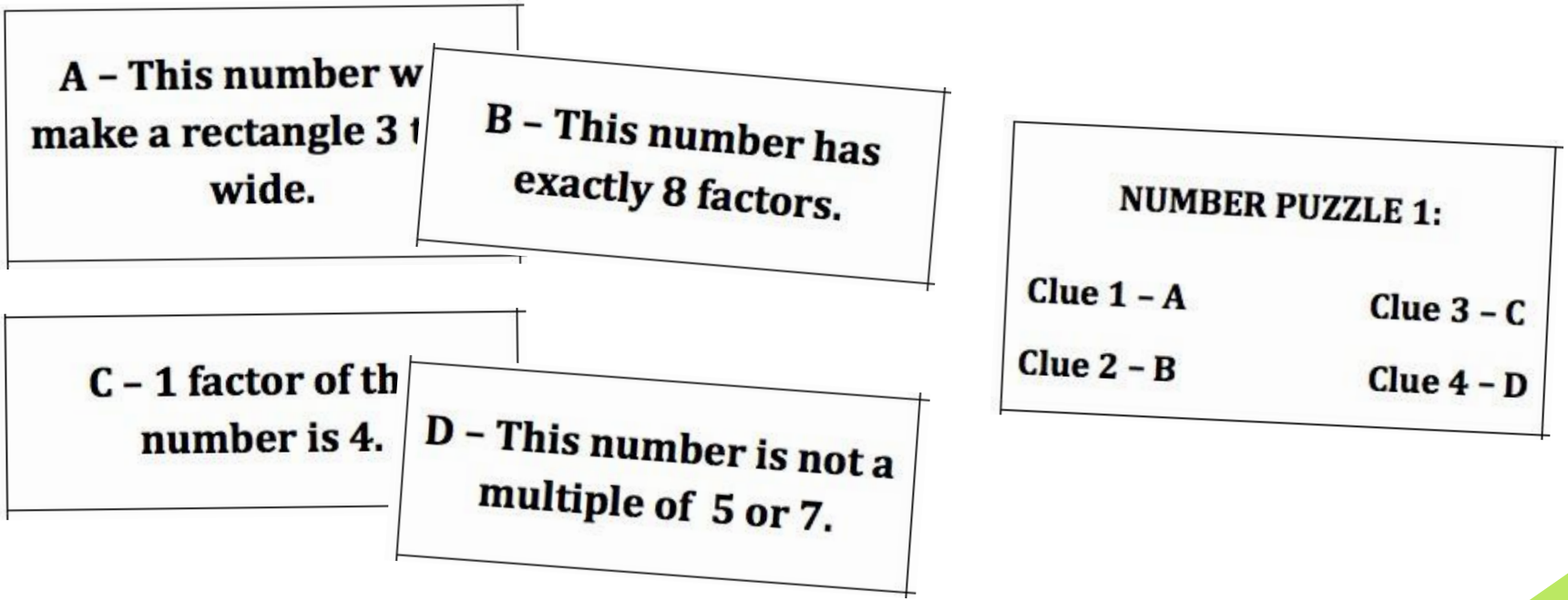
Creating a Classroom that Supports Productive Struggle

Student Actions

Foster student ownership

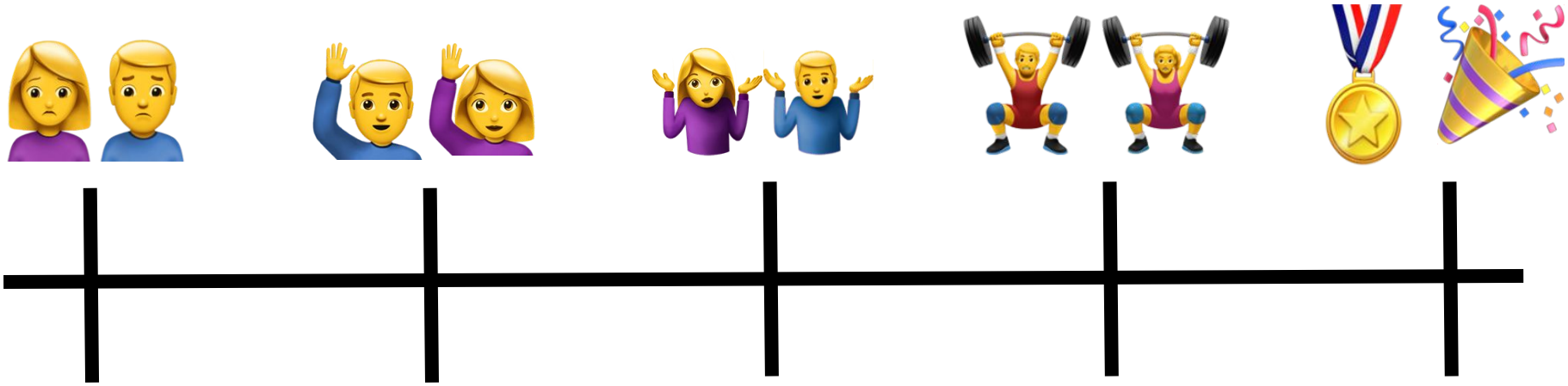
- Evidence of Learning
- Goal setting
- Reflection Self-Assessment

Number Puzzles Card Sort



http://teresaemmert.weebly.com/4th-grade-fals.html

Productive Struggle Scale



1

I'm frustrated and need help.

2

I'm stuck and could use a hint.

3

I'm not sure what to do next and could use a question.

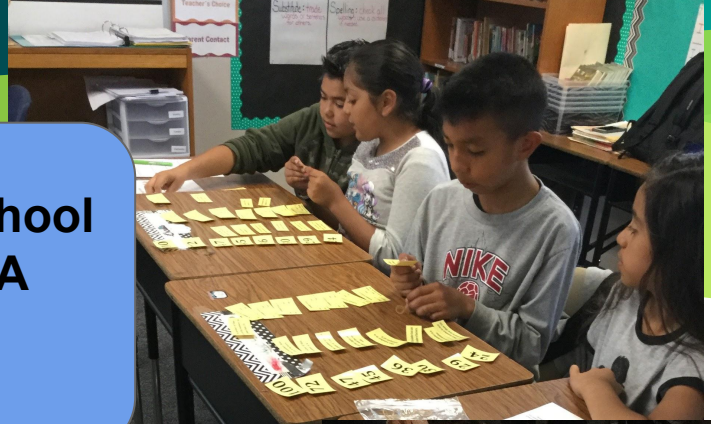
4

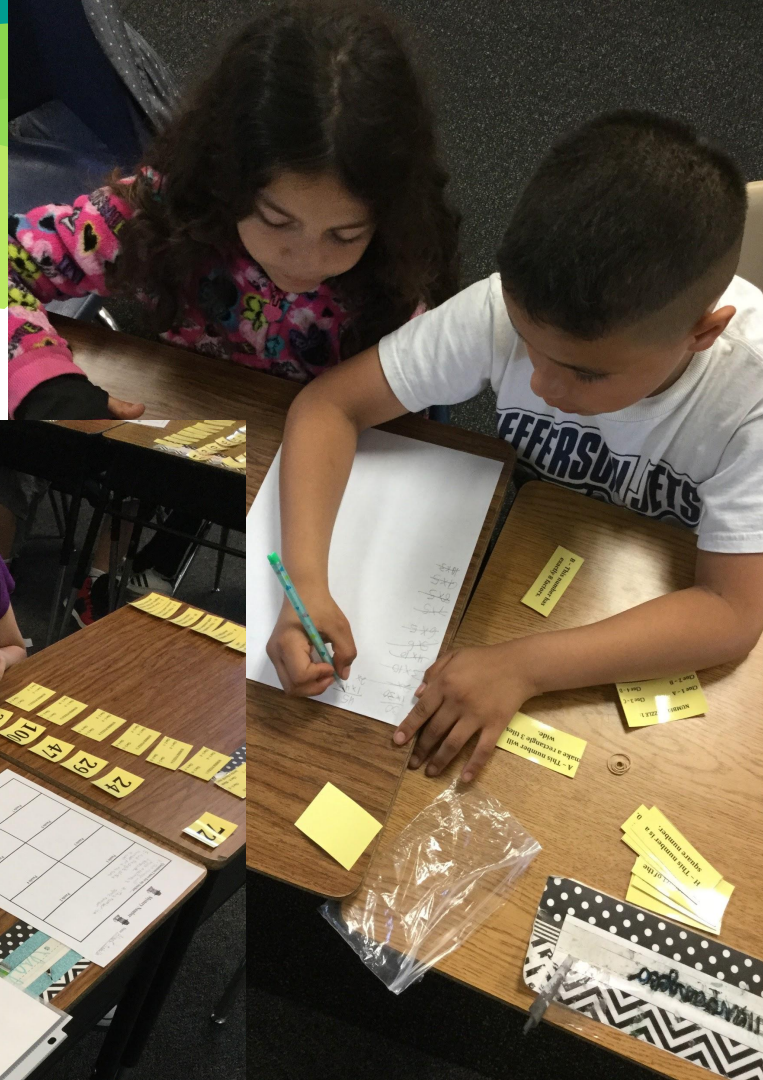
I have an idea and am exploring. Give me some time.

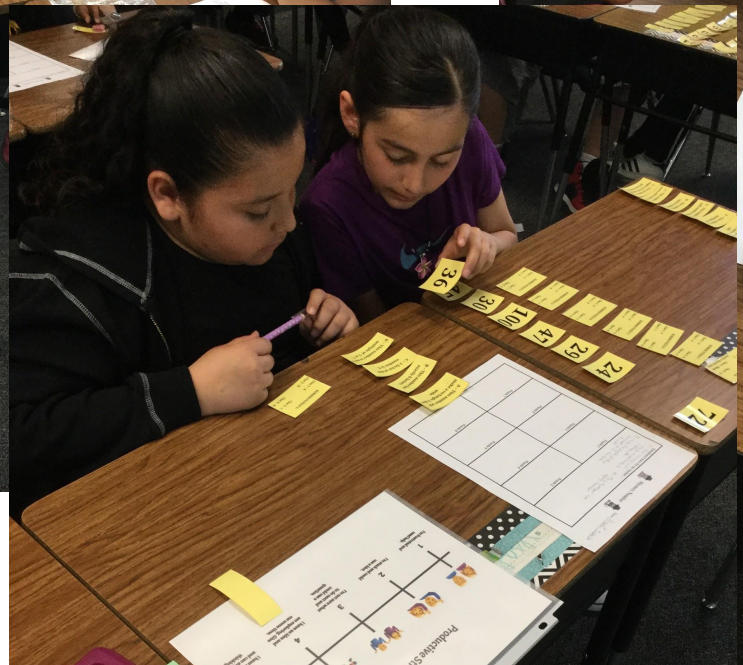
5

I have an approach and can explain my thinking.

Jefferson School
Dinuba, CA
Mrs. Hall
4th Grade







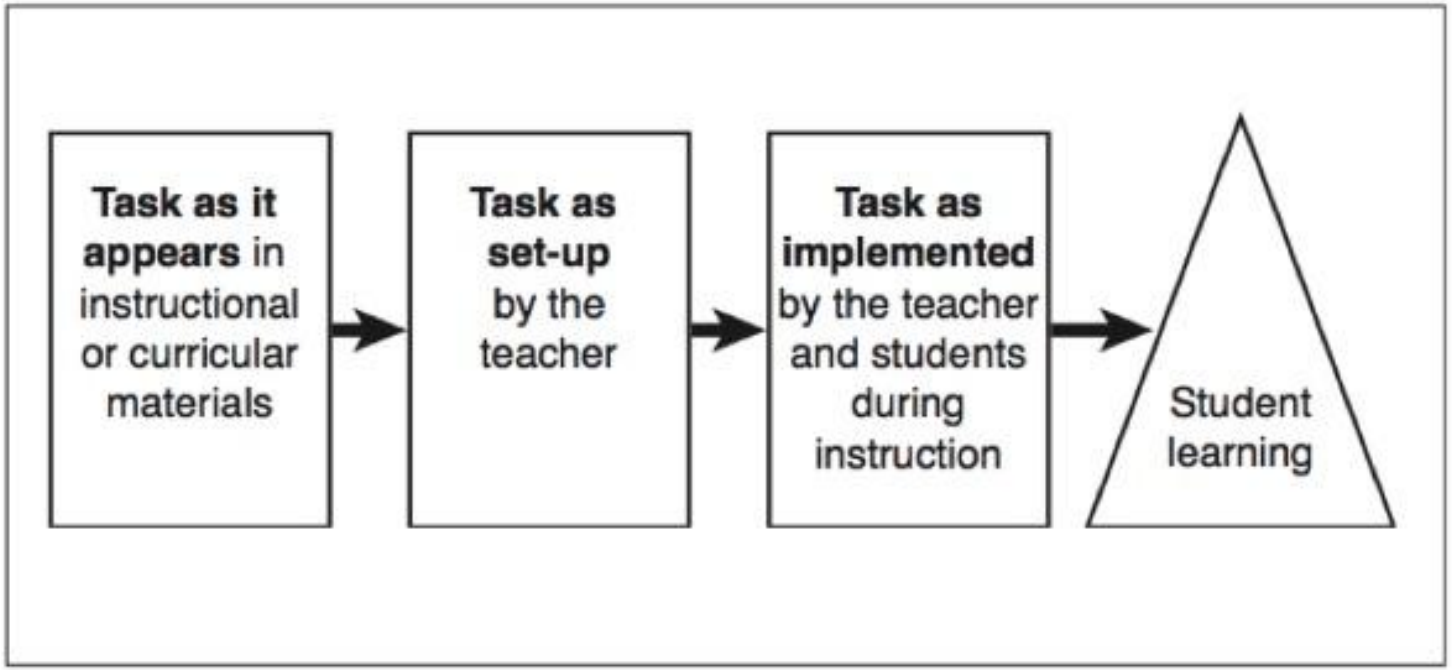
Number Puzzles Card Sort Reflection

- How did the task promote reasoning and problem solving?
- Which aspects of the task do you think would be challenging for students?
- What supports would you put into place and why?

Strategies to Support Students in Productive Struggle

What types of supports can we provide students as they grapple with mathematical ideas and relationships?

Mathematical Task Framework



Stein et al., 2000

Low Floor High Ceiling Task

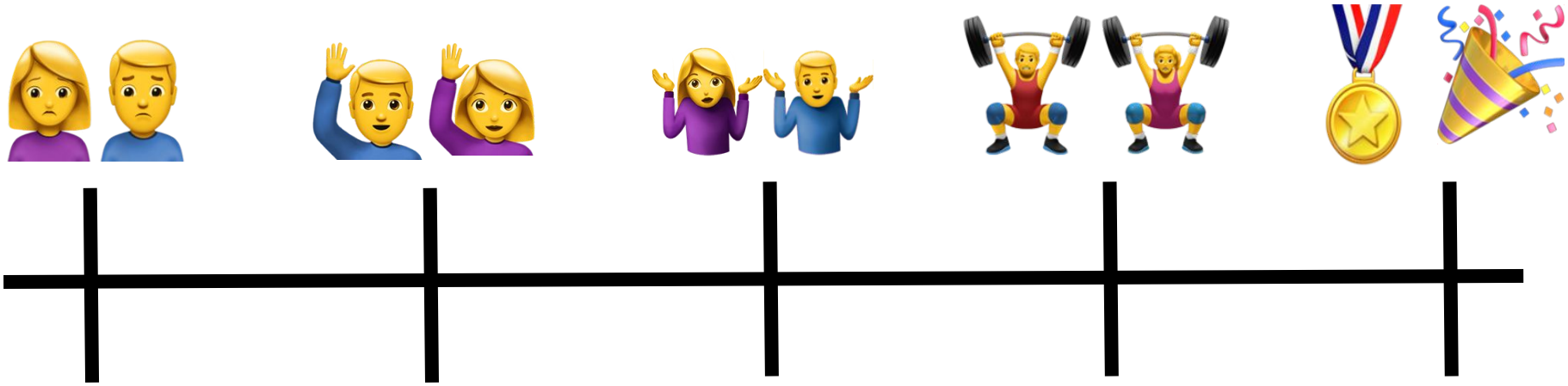
What's the Secret Code?
Green Group

1. Use the clues to find the code number:
   - It is between 8,500 and 8,800.
   - When multiplied by 8, the result is a whole number.
   - The digit in the hundreds place is $\frac{3}{4}$ the digit in the thousands place.
   - The sum of all digits in the number is 26.
   - The digit in the hundredths place is 200% of the digit in the tenths place.
   - There are no zeros in the decimal places.

2. What code numbers fit these clues?

http://youcubed.org/teachers/category/low-floor-high-ceiling/

Productive Struggle Scale



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The Secret Code Reflection

- How did the task promote reasoning and problem solving?
- Which aspects of the task do you think would be challenging for students?
- What supports would you put into place and why?

Student Support

Beginning of the Task

- Read and Flip
- Individual Think/Work Time
- Group Huddle

Student Support

During the Task

- Spy
- Collaborative Structures
- Teacher Questioning

Supporting Students through Questioning

- Could you explain a little more about _____?
- Can you help me understand your work so far?
- I really like what you did here, and I'm wondering about _____?
- Are there any patterns you noticed?
- I'm wondering if you _____?

Mindset and Feedback

In what ways do mindsets impact how students view and approach challenging situations?

Reframing Struggle as Expending Effort

https://flic.kr/p/8GnE1X

https://i.ytimg.com/vi/ST7DhwKdkC0/maxresdefault.jpg

Matt Larson, “Seeking Equilibrium” CMC South 2015 Ignite

From . . .	To . . .
I don't get it.	I am confused on this part, but with a little help I know I can figure it out.
Math is hard.	Math is challenging. When I work hard at it, I can figure it out.
I give up.	If I stick with it and try different ideas, I can find a way to complete the problem.

Communicating Your Goals about Productive Struggle

Students

- Explain your expectations to students
- Discuss struggle with students
- You are not trying to be unhelpful, you are trying to help them learn

Others

- Share what you are doing with your students and why
- Explain how you offer support for struggling students

Adapted from Robert Kaplinsky, “Productive Struggle” CMC South Ignite 2015

Expectations for students	Teacher actions to support students	Classroom-based indicators of success
Most tasks that promote reasoning and problem solving take time to solve, and frustration may occur, but perseverance in the face of initial difficulty is important.	Use tasks that promote reasoning and problem solving; explicitly encourage students to persevere; find ways to support students without removing all the challenges in a task.	Students are engaged in the tasks and do not give up. The teacher supports students when they are "stuck" but does so in a way that keeps the thinking and reasoning at a high level.
Correct solutions are important, but so is being able to explain and discuss how one thought about and solved particular tasks.	Ask students to explain and justify how they solved a task. Value the quality of the explanation as much as the final solution.	Students explain how they solved a task and provide mathematical justifications for their reasoning.
Everyone has a responsibility and an obligation to make sense of mathematics by asking questions of peers and the teacher when he or she does not understand.	Give students the opportunity to discuss and determine the validity and appropriateness of strategies and solutions.	Students question and critique the reasoning of their peers and reflect on their own understanding.
Diagrams, sketches, and hands-on materials are important tools to use in making sense of tasks.	Give students access to tools that will support their thinking processes.	Students are able to use tools to solve tasks that they cannot solve without them.
Communicating about one's thinking during a task makes it possible for others to help that person make progress on the task.	Ask students to explain their thinking and pose questions that are based on students' reasoning, rather than on the way that the teacher is thinking about the task.	Students explain their thinking about a task to their peers and the teacher. The teacher asks probing questions based on the students' thinking.

NCTM's Principles to Actions: Ensuring Mathematical Success for All

Types of Tasks that Promote Productive Struggle

- Low Floor – High Ceiling Tasks
- Sorting Tasks
- Word problems
- Formative Assessment Lessons
- Real-world tasks
- Open Middle Tasks
  (Open beginning & Open ended tasks too!)

Productive Struggle

- Revisit your definition of productive struggle.
- Add to, revise, or adjust your definition based on what you have learned.

Session Reflection

Stop - what is something that you want to stop doing based on what you learned?

Continue - what is something that you want to continue doing based on what you learned?

Start - what is something that you want to start doing based on what you learned?

Session Outcomes

- Learn ways to create a culture that supports productive struggle.
- Develop strategies to help students build perseverance as they makes sense of and solve problems.
- Explore ways to select and structure tasks to engage students in productive struggle.

Resources

- NCTM's Principles to Actions: Ensuring Mathematical Success for All
- YouCubed Tasks, http://youcubed.org/teachers/category/low-floor-high-ceiling/
- Robert Kaplinsky, "Productive Struggle" CMC South Ignite 2015
- Open Middle, http://www.openmiddle.com/
- Andrew Stadel, Blog Series on Productive Struggle and Desmos Activity, http://mr-stadel.blogspot.com/2015/12/productive-struggle-part-1.html
- Teresa Emmert, http://teresaemmert.weebly.com/4th-grade-fals.html
- "My Favorite No," https://www.teachingchannel.org/videos/class-warm-up-routine
- Celebrating Mistakes, https://www.youcubed.org/think-it-up/mistakes-grow-brain/

Thank you and enjoy your time at the NCTM Annual Conference!

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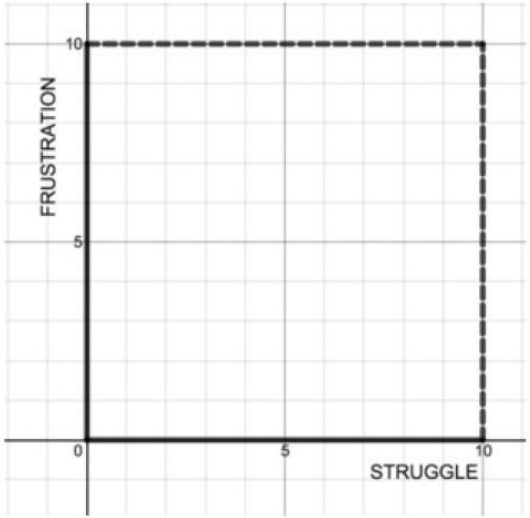
K-8 District Academic Coach - Mathematics

DINUBA UNIFIED SCHOOL DISTRICT
Cultivating Excellence

Desmos Activity: Productive Struggle



- Go to: student.desmos.com
- Enter code: **Y6TT**
- Created by Andrew Stadel.

Productive Struggle – Desmos Activity Created by Andrew Stadel
https://teacher.desmos.com/activitybuilder/custom/566522dc20907121403d40f9