



Who is doing the thinking?

Engaging students in Authentic Problem Solving

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Objectives

Engage

Engage in an open problem solving task

Evaluate

Evaluate the task based on Jo Boaler's 5 C's of Mathematics Engagement and the NCTM Math.

Revise

Revise a typical textbook problem to allow for more student thinking and engagement that incorporate the 5 C's.

Task: Which Scripts?

There are six numbers written in five different scripts.

Can you sort out which is which?

Write 51 in each script.

୧୦୦	13	୫୮	୧୩	୧+୫
୧୩	୧	୨୫	୫୩	୧୦୦
=	୫+୮	2	୧୦	-୫
୧୫	୮୩	୧୩	୨	58
25	୮୦	୨	୮+୩	୧୦
୫୮	+୩	100	୫୮	୨୫

Student Reflections

1. Were you able to successfully crack the code?

- If so, describe your process for solving the problem in the space below.
- If not, what could you improve about the process? Use the space below.

We started with the numbers we knew and then looked for similar symbols.

1. Were you able to successfully crack the code?

- If so, describe your process for solving the problem in the space below.
- If not, what could you improve about the process? Use the space below.

Yes we were,

First: Found 0's and 3 digit numbers

Next: Process of Elimination

Then: Single digit numbers

Finally: We used assumption for Japanese symbols

Mission Debrief

the code?

cess for solving the problem in the space below.

mprove about the process? Use the space below.

yes

We started with the numbers we knew and we looked for details. We looked at the similar properties of the funky numbers and when we found out the other categories by looking at the numbers we figured out.

5 C's of
Mathematics
Engagement

Curiosity

Connection Making

Challenge

Creativity

Collaboration

Mathematical Practices

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Shape Times Shape



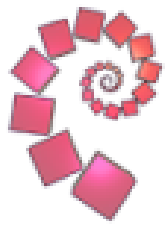
The coloured shapes stand for eleven of the numbers from 0 to 12.

Each shape is a different number.

Can you work out what they are?



$\square \times \square \times \square = \text{C}$	$\text{R} \times \text{R} = \text{S}$
$\square \times \text{O} = \text{C}$	$\square \times \text{P} = \text{H}$
$\text{R} \times \text{O} = \text{C}$	$\text{R} \times \text{D} = \text{R}$
$\text{R} \times \square = \text{T}$	$\text{D} \times \text{H} = \text{H}$
$\text{T} \times \square = \text{C}$	$\square \times \text{I} = \text{I}$
$\square \times \square = \text{O}$	$\text{I} \times \text{C} = \text{I}$



Shapes Times Shape



= 8 because...



= 9 because...



= 0 because...



= 4 because...



= 2 because...



= 10 because...



= 1 because...



= 5 because...



= 12 because...



= 6 because...



= 3 because...

Everyone can
learn math
to the
highest levels

Mistakes are
valuable

Questions are
really important

Math is about
creativity and
making sense

Math is about
connections and
communicating

Math class is
about learning not
performing

Depth
is more important
than speed

Positive Math Norms

Welcome to the home of rich mathematics

Search by Topic

Search by Topic

If you are looking for resources on a particular curriculum topic, we recommend you start by taking a look at our curriculum mapping documents, available on the [Primary](#) and [Secondary](#) Teacher pages.

Search for a topic: search

or select from the list below

Broad topic

- 3D Geometry, Shape and Space
- Advanced Probability and Statistics
- Algebraic expressions, equations and formulae
- Angles, Polygons, and Geometrical Proof
- Calculations and Numerical Methods
- Calculus
- Coordinates, Functions and Graphs
- Cross-curricular Connections

Math Class Needs a Makeover




Which problem allows for more student thinking?

Name _____

Reteaching
7-6

Problem Solving: Look for a Pattern

The children need mittens.
Each child has two hands.
How many mittens are needed for all of the children?



You need to find how many hands the children have altogether.

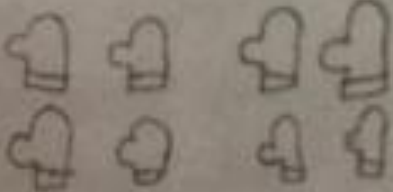
Make a table to show a pattern.
Write the numbers.

Number of Children	1	2	3	4
Number of Mittens	2	4	6	8

Count the children by 1s.
Count the mittens by 2s.

8 mittens will be needed for all of the children.
Does your answer make sense?

Four kids want to play in the snow.
How many mittens do they need?



Boaler's 6 Suggestions to Open a Task

Multiple Paths	Ensure there are multiple methods, pathways, and representations.
Inquiry	Include inquiry opportunities.
Ask	Ask the problem before teaching the method.
Visual	Add a visual component and ask students how they see the mathematics.
Accessible	Extend the task to make it lower floor and higher ceiling.
Reason	Ask students to convince and reason; be skeptical.

Tracey Johnston Zager's Questions to Make Over a Problem



1. What is the math here?



2. Is this problem a good fit for that math, or other, interesting math?



3. If you were going to teach this problem, how would you revise it?



4. Do you see ways to lower the threshold? Raise the ceiling? Open the middle?

How can you make over this problem to allow for more student thinking?

Follow these steps for each problem.

- a. Decide which two numbers need to be multiplied to give the exact answer. Write the two numbers.
- b. Estimate whether the answer will be in the tens, hundreds, thousands, or more. Write a number model for the estimate. Circle the box to show your estimate.
- c. On the grid below, find the exact answer by multiplying the two numbers. Write the answer.

1. The average person in the United States drinks about 61 cups of soda per month. About how many cups of soda is that per year?

a. _____ * _____

Numbers that give the exact answer

b. _____

number model for your estimate

c. _____

Exact answer

Embracing the Productive Struggle

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 (2014. 48). –NCTM *Principles to Actions*

Productive Struggle	Destructive Struggle
Leads to understanding.	Leads to frustration.
Makes learning goals feel attainable and effort seem worthwhile.	Makes learning goals feel hazy and out of reach.
Yields results.	Feels fruitless.
Leads students to feelings of empowerment and efficacy.	Leaves students feeling abandoned and on their own.
Creates a sense of hope.	Creates a sense of inadequacy.

NCTM Effective Math Teaching Practices

Establish mathematics goals to focus learning

Implement tasks that promote reasoning and problem solving.

Use and connect mathematical representations.

Facilitate meaningful mathematical discourse.

Pose purposeful questions.

Build procedural fluency from conceptual understanding.

Support productive struggle in learning mathematics.

Support productive struggle in learning mathematics.

Elicit and use evidence of student thinking.

Resources to Implement Mathematical Mindsets

<https://nrich.maths.org>

<https://www.youcubed.org/week-inspirational-math/>

<https://www.nctm.org>

<https://www.openmiddle.com/>

<https://tasks.illustrativemathematics.org/content-standards>

<https://gfletchy.com/3-act-lessons/>

Resources

Boaler, J., & Dweck, C. S. (2016). *Mathematical mindsets: unleashing students' potential through creative math, inspiring messages and innovative teaching*. First edition. San Francisco, CA: Jossey-Bass; a Wiley Brand.

Zager, T.J. (2017). *Becoming the math teacher you wish you'd had: ideas and strategies from vibrant classrooms*. Portland, ME: Stenhouse Publishers.

(2014). *Principles to actions : ensuring mathematical success for all*. Reston, VA :NCTM, National Council of Teachers of Mathematics.

Reflection: Based on what you learned today....

.....what will you start doing?

.....what will you stop doing?

.....what will you do differently?