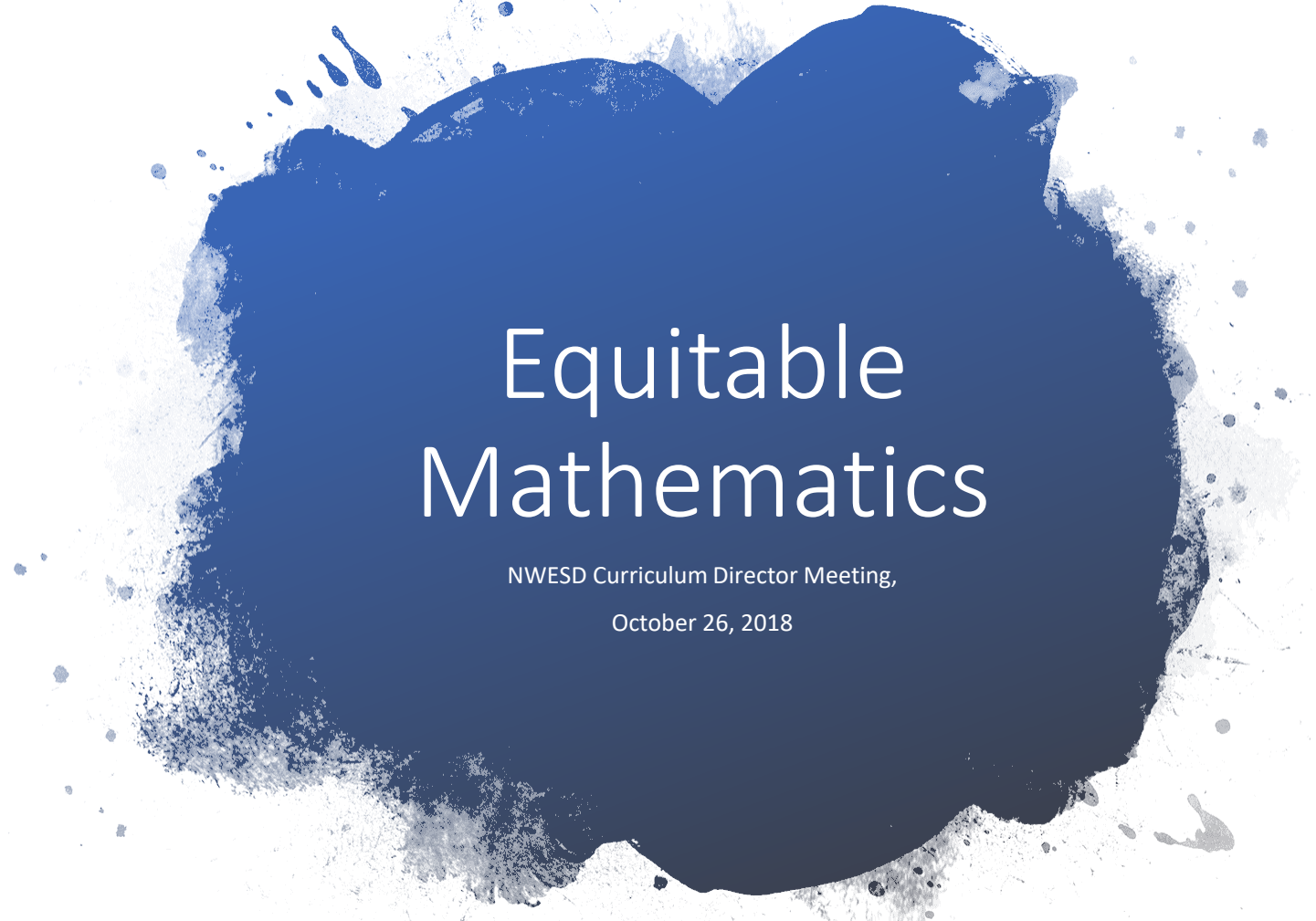


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# Equitable Mathematics

NWESD Curriculum Director Meeting,  
October 26, 2018



Jessica Cohen, Associate Professor

Mathematics, WWU

Rey Ramos, PK-12 Math TOSA



Bellingham

Charisse Berner, Director

Teaching and Learning, B'ham




**High-quality Student  
Learning: *The case of  
mathematics***



**Special thanks to**  
Jessica Rigby (L4L Core Faculty) &  
Emily Shahan  
NCTM



# Today's Goals

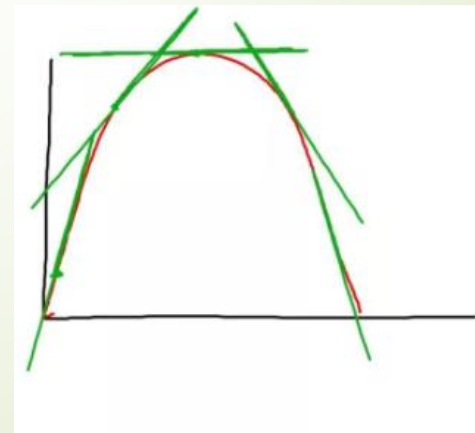
1. Experience several mathematics tasks and instructional implementations
  2. Reflect and discuss the difference between the tasks/implementations and why this is consequential
- 

# Our Social-Emotional State with Mathematics

*What is your relationship with  
mathematics?*

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\begin{aligned} \int x^n e^{cx} dx &= \frac{1}{c} x^n e^{cx} - \frac{n}{c} \int x^{n-1} e^{cx} dx \\ &= \left( \frac{\partial}{\partial c} \right)^n \frac{e^{cx}}{c} \\ &= e^{cx} \sum_{i=0}^n (-1)^i \frac{n!}{(n-i)! c^{i+1}} x^{n-i} \\ &= e^{cx} \sum_{i=0}^n (-1)^{n-i} \frac{n!}{i! c^{n-i+1}} x^i \end{aligned}$$





What is High Quality Instruction?



Let's do some mathematics

You're a student entering classroom  
A. You are ready  
to learn.

Classroom A

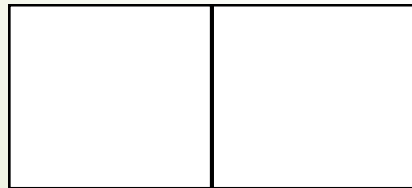
# The Square Pattern Task

- Using the side of a square pattern tile as a measure, find the perimeter (i.e., the distance around) of each train in the pattern of the figure shown below.

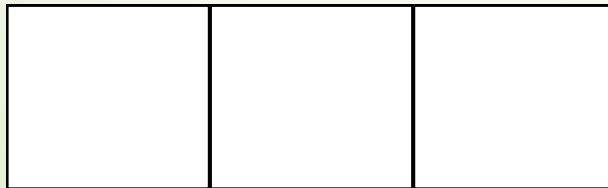
Train 1



Train 2



Train 3



Name : \_\_\_\_\_

Score : \_\_\_\_\_

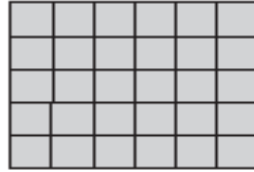
**Perimeter**

ES1



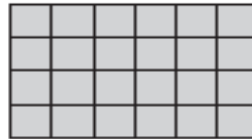
Calculate the perimeter of each shape.

1)



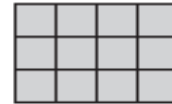
Perimeter = \_\_\_\_\_

2)



Perimeter = \_\_\_\_\_

3)



Perimeter = \_\_\_\_\_

4)



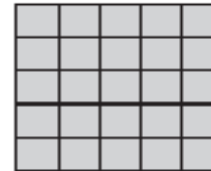
Perimeter = \_\_\_\_\_

5)



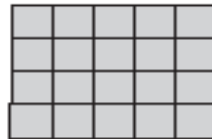
Perimeter = \_\_\_\_\_

6)



Perimeter = \_\_\_\_\_

7)



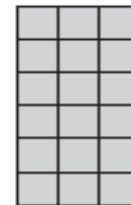
Perimeter = \_\_\_\_\_

8)



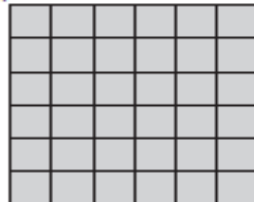
Perimeter = \_\_\_\_\_

9)



Perimeter = \_\_\_\_\_

10)



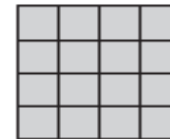
Perimeter = \_\_\_\_\_

11)



Perimeter = \_\_\_\_\_

12)



Perimeter = \_\_\_\_\_

### Quadrilateral-Perimeter

Find the perimeter of each quadrilateral.

1)



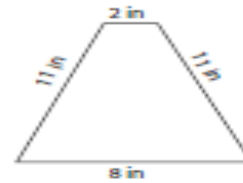
Perimeter = \_\_\_\_\_

2)



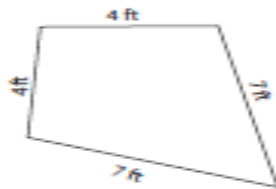
Perimeter = \_\_\_\_\_

3)



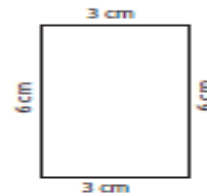
Perimeter = \_\_\_\_\_

4)



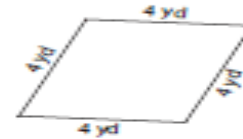
Perimeter = \_\_\_\_\_

5)



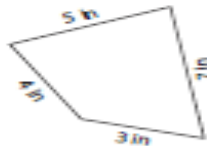
Perimeter = \_\_\_\_\_

6)



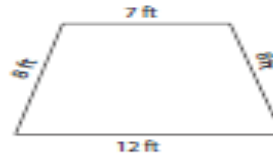
Perimeter = \_\_\_\_\_

7)



Perimeter = \_\_\_\_\_

8)



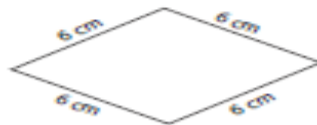
Perimeter = \_\_\_\_\_

9)



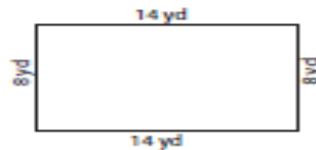
Perimeter = \_\_\_\_\_

10)



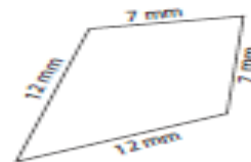
Perimeter = \_\_\_\_\_

11)



Perimeter = \_\_\_\_\_

12)



Perimeter = \_\_\_\_\_



Let's do some mathematics

You are entering the classroom.  
Here is what you see...

Classroom B

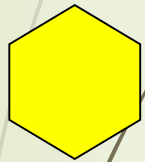
- American English: perimeter
- Brazilian Portuguese: perímetro
- Chinese: 周边
- European Spanish: perímetro
- French: périmètre
- German: Umfang
- Italian: perimetro
- Japanese: 周囲
- Korean: 둘레
- European Portuguese: perímetro
- Spanish: perímetro
- Filipino: buong gilid



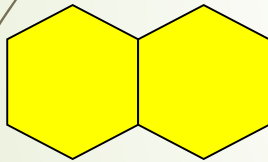
# 3. The Hexagon Pattern Task

14

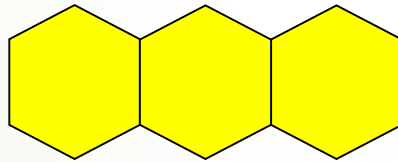
For the pattern shown below, compute the perimeter for the first three trains, determine the perimeter of the tenth train without constructing it, and then write a description that could be used to compute the perimeter of any train in the pattern.



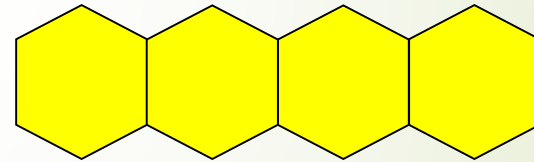
train 1



train 2



train 3



train 4



Let's pause and think about the two classes you experienced.

The slide features a light green background with a vertical gradient. On the left side, there are several thin, dark, curved lines that sweep upwards and to the right, resembling stylized grass or abstract brushstrokes. The text is centered in the upper half of the slide.

In your math journey, how many  
experienced mostly **Classroom A**?

The slide features a light green background with a vertical gradient. On the left side, there are several thin, dark, curved lines that resemble stylized grass or reeds, extending from the bottom towards the top.

In your math journey, how many  
experienced mostly **Classroom B**?

**Group 1's Solution**

Each hex has 2 sides on the top and 2 on the bottom that count. So that's 4. Then you need to add the two on the ends. It is  $P = 4h + 2$

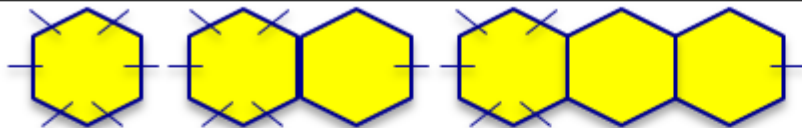
**Group 2's Solution**

There are five sides on each end of the train. Then every time you add another hexagon there are 4 more sides on the inside - 2 on the top and 2 on the bottom.

**Group 3's Solution**

Train #	Perimeter
1	6
2	10
3	14
4	18
5	22
6	26
7	30
8	34

The perimeter of each train is 4 more. So if you multiply the number of hexagons by 4 you need to add on 2 to get the right perimeter.

**Group 4 Solution**

The first hexagon train has six sides. When you go to bigger trains the right side of the first hexagon moves to the end of the train. Each of the other hexagons in a train adds 4 sides to the perimeter.  $P = 4(h - 1) + 6$

**Group 5's Solution**


Each hexagon has six sides, but all of them don't count. So you have to get rid of the vertical ones. So that would be  $2x$ . But you then have to add two back for the sides on the ends.  $P = 6h - 2h + 2$

# Implementation Matters: *Proceduralization of Tasks*




**PROCEDURES ARE THE ANSWER**

# Why is this consequential?



“Students learn from the kind of work they do during class...If they spend most of their time practicing paper-and-pencil skills on sets of worksheet exercises, they are likely to become faster at executing those skills. If they spend most of their time watching the teacher demonstrate methods for solving special kinds of problems, they are likely to become better at imitating these methods on similar problems. If they spend most of their time reflecting on the way things work, on how various ideas and procedures are the same and different, on how what they already know relates to the situations they encounter, they are likely to build new relationships. That is, they are likely to construct new understandings” (Hiebert et al., 1997)



“ Drill and Kill... never helped a student develop a good relationship with mathematics...”

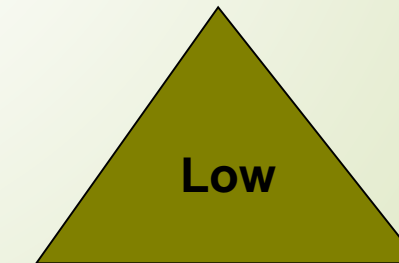
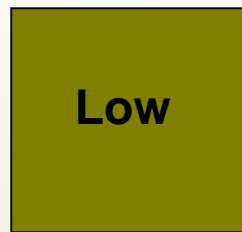
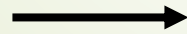
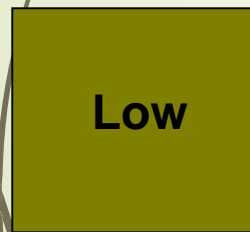
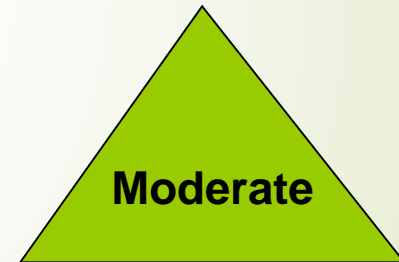
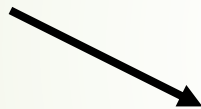
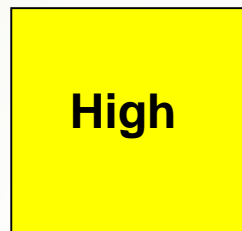
Marzano, 2009

# Linking to Research: QUASAR (1990-1996)

Task Potential

Task Implementation

Student Learning





# Who has access?

- ▶ **Not many students.**
- ▶ **TIMMS:** 15% (of 100) of instructional tasks were high quality, less than 1% were implemented in ways that supported students' development of mathematical concepts (Hiebert et al., 2003)
- ▶ **Inside Classroom Study:** 15% (of 364) of observed lessons in mathematics and science were rated as high quality (based on criteria of intellectual rigor, teacher questioning for conceptual understanding, and students' opportunities for sense-making) (Weiss et al., 2003)

# What our students see

## SHEET 1

To multiply a fraction by an integer, simply multiply the numerator by the integer. Remember also that  $\frac{1}{3} \times 5$  is the same as  $\frac{1}{3}$  of 5.

Example  $\frac{2}{5} \times 6 = \frac{2 \times 6}{5} = \frac{12}{5}$



Multiply these fractions, leaving your answer as an improper fraction where appropriate.

1)  $\frac{1}{3} \times 5 = \frac{\quad}{3}$     2)  $\frac{1}{5}$  of 7 =  $\frac{\quad}{5}$     3)  $8 \times \frac{1}{7} = \frac{\quad}{7}$

4)  $\frac{2}{3}$  of 4 =  $\frac{\quad}{3}$     5)  $\frac{1}{6} \times 11 = \frac{\quad}{6}$     6)  $\frac{3}{4} \times 3 = \frac{\quad}{4}$

7)  $2 \times \frac{4}{5} = \frac{\quad}{5}$     8)  $4 \times \frac{2}{9} = \frac{\quad}{9}$     9)  $9 \times \frac{1}{2} = \frac{\quad}{2}$

10)  $\frac{1}{8}$  of 15 =  $\frac{\quad}{8}$     11)  $\frac{2}{7} \times 6 = \frac{\quad}{7}$     12)  $8 \times \frac{3}{7} = \frac{\quad}{7}$

13)  $7 \times \frac{5}{6} = \frac{\quad}{6}$     14)  $6 \times \frac{4}{9} = \frac{\quad}{9}$     15)  $\frac{2}{7} \times 8 = \frac{\quad}{7}$

16)  $\frac{3}{8} \times 11 = \frac{\quad}{8}$     17)  $\frac{4}{7}$  of 9 =  $\frac{\quad}{7}$     18)  $11 \times \frac{5}{6} = \frac{\quad}{6}$

19)  $12 \times \frac{4}{5} = \frac{\quad}{5}$     20)  $\frac{2}{7} \times 16 = \frac{\quad}{7}$     21)  $24 \times \frac{1}{9} = \frac{\quad}{9}$

Kelly has 6 pies. What fraction does she need to multiply these pies by to evenly divide these pies among 4 friends?

$$\boxed{\phantom{000}} \times \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{000}}$$

Draw a fraction model to prove that your answer is correct:

# But less so for students of color and those who live in poverty

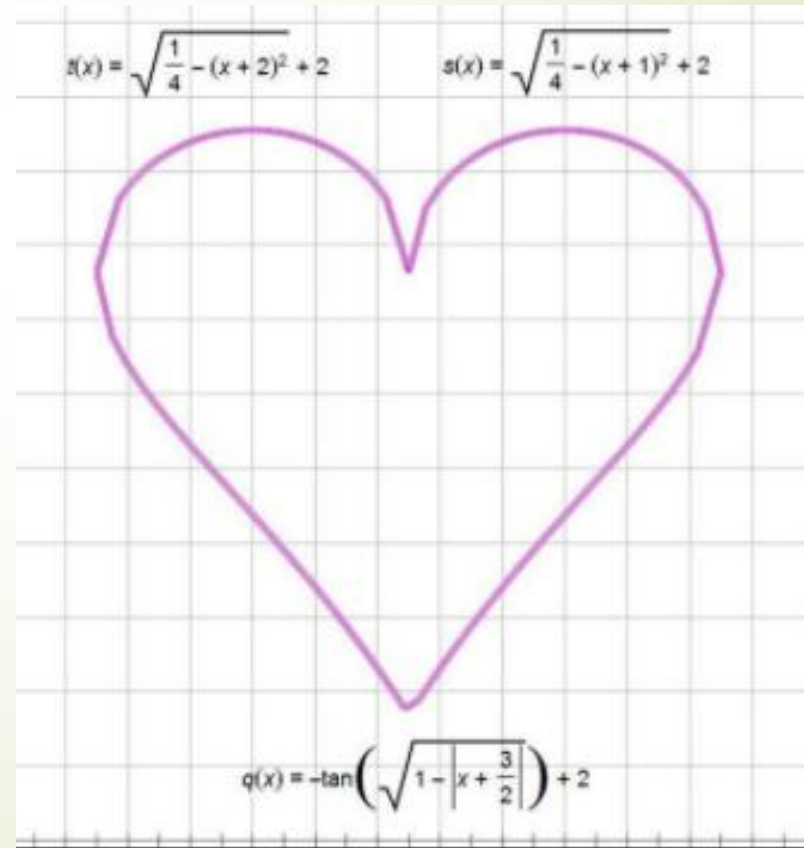
- **Tracking research**
- Low-income students and students of color are disproportionately represented in low tracks (Oakes, 1985; Oakes, 1990)
- **Pedagogy of poverty**
- **Non-Interactive and Extreme Direct instruction + expected compliance:** “sufficiently powerful to undermine the implementation of any reform effort because it defines the way pupils spend their time, the nature of the behaviors they practice, and the basis of their **self concept** as learners. Essentially, it is a pedagogy in which learners can “succeed” without becoming either involved or thoughtful.” (Haberman, 1991, 2010)
- Classes with majority of students of color and/or English Learners were more likely to have proceduralized lessons.



# Leading for more equitable access

- How does this problem connect with your work?
- What is the critical feedback we can give each other?

Math is beautiful and lovable...and it's time to rekindle the good relationship...







## Calculus article

- How does this article connect to the work in San Francisco Unified School District?

<http://www.sfusdmath.org/>

- What resonates with your thinking about high school math given the data shared by Jessica?
- What challenges do you think this raises?

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## Resources to consider

- *How People Learn 2* <https://www.nap.edu/catalog/24783/how-people-learn-ii-learners-contexts-and-cultures>.
- *Catalyzing Change in High School Mathematics*  
<https://www.nctm.org/Store/Products/Catalyzing-Change-in-High-School-Mathematics/>
- Jo Boaler's *You Cubed* and *Mathematical Mindsets*  
<https://www.youcubed.org/mathematical-mindset-teaching-resources/>

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# Exit Ticket



One thing that  
pushed your thinking



One question you  
have