

# The Promise of Scaffolded Math Curriculum for Middle-School English Learners: Project MELD

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# Project MELD Team

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## **AIR Team**

- Diane August: Principal Investigator
- Ashley Simpson Baird: Project Director, English Learner Lead
- Alexandra Marken: Research Associate
- Tad Johnston: Mathematics Lead
- Kirk Walters: Senior Advisor

## **Rice University**

- Chris Barr: Methodologist

## **Rio Grande Valley Language and Learning Center**

- Elsa Cardenas Hagan: On-site Coordinator
- Benny Hernandez: On-site Research Associate

# LearnZillion Team

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- Posie Wood
- Jodi Rothstein
- Eric Westendorf
- Beth McHugh
- Ian Lotinsky

Base Math Curriculum used for MELD is adapted from LearnZillion

# Project MELD Overview

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# What is Project MELD?

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- IES-funded, five-year study to enhance sixth-grade, Spanish-speaking ELs' math knowledge and academic language associated with math.
- Research questions:
  - *To what extent can the intervention be implemented successfully? What programmatic changes and enhancements are needed to improve the intervention?*
  - *How does Project MELD affect students' math learning and development of math-related academic language?*

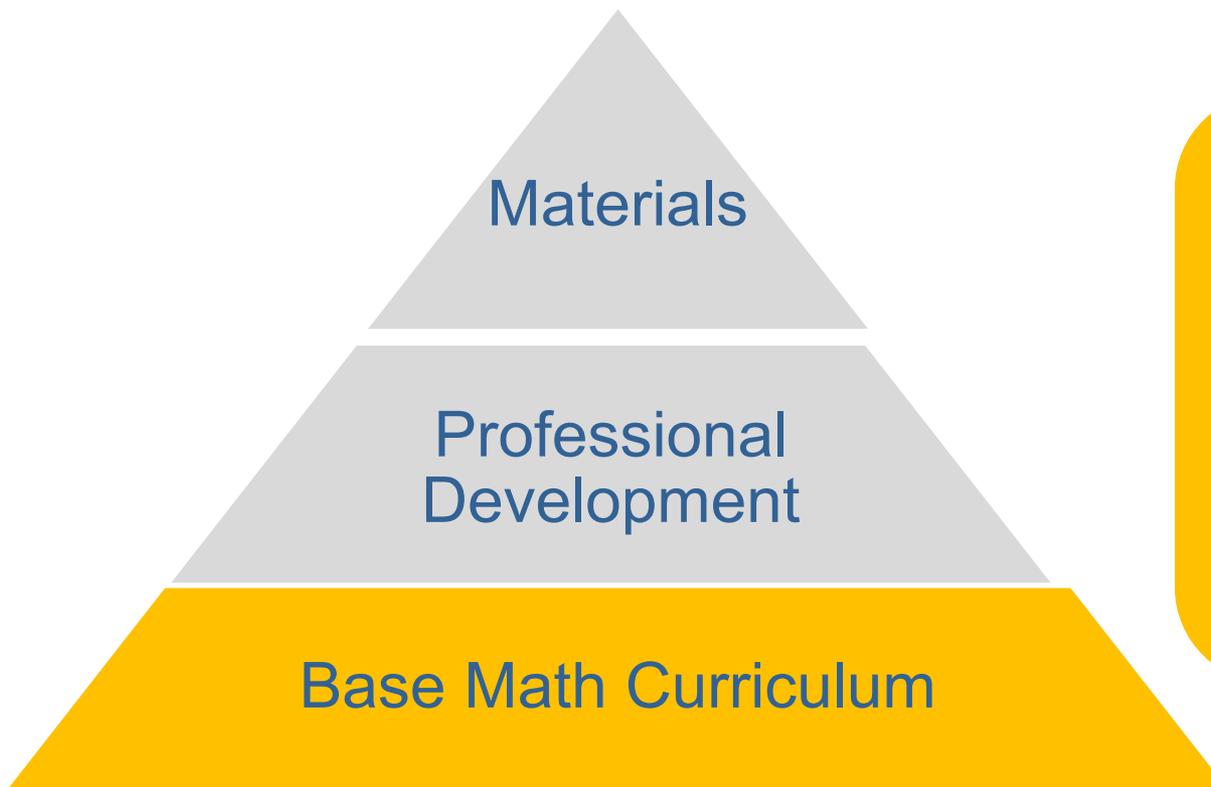
# Research Base

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- **Few experimental studies on literacy and content-area instruction in middle grades** (Baker et al., 2014; National Academy of Sciences, Engineering and Math, 2017).
- **Student learning is greater when**
  - academic vocabulary is taught intensively across several days;
  - oral and written English language is integrated with content;
  - there are regular structured opportunities to develop written language skills; and
  - small-group instructional interventions are provided to students struggling in areas of literacy and English language development.

# What is the intervention?

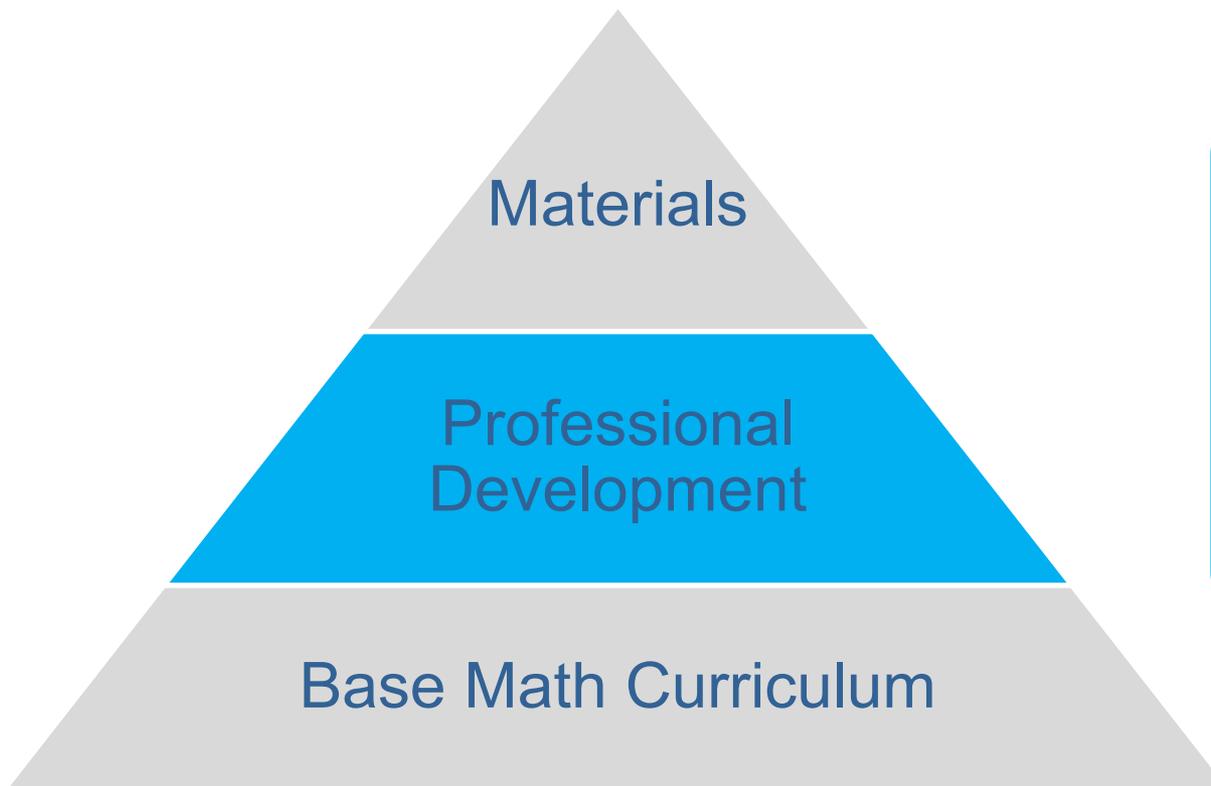
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LearnZillion (LZ)  
curriculum  
developed by  
exemplary  
teachers

# What is the intervention?

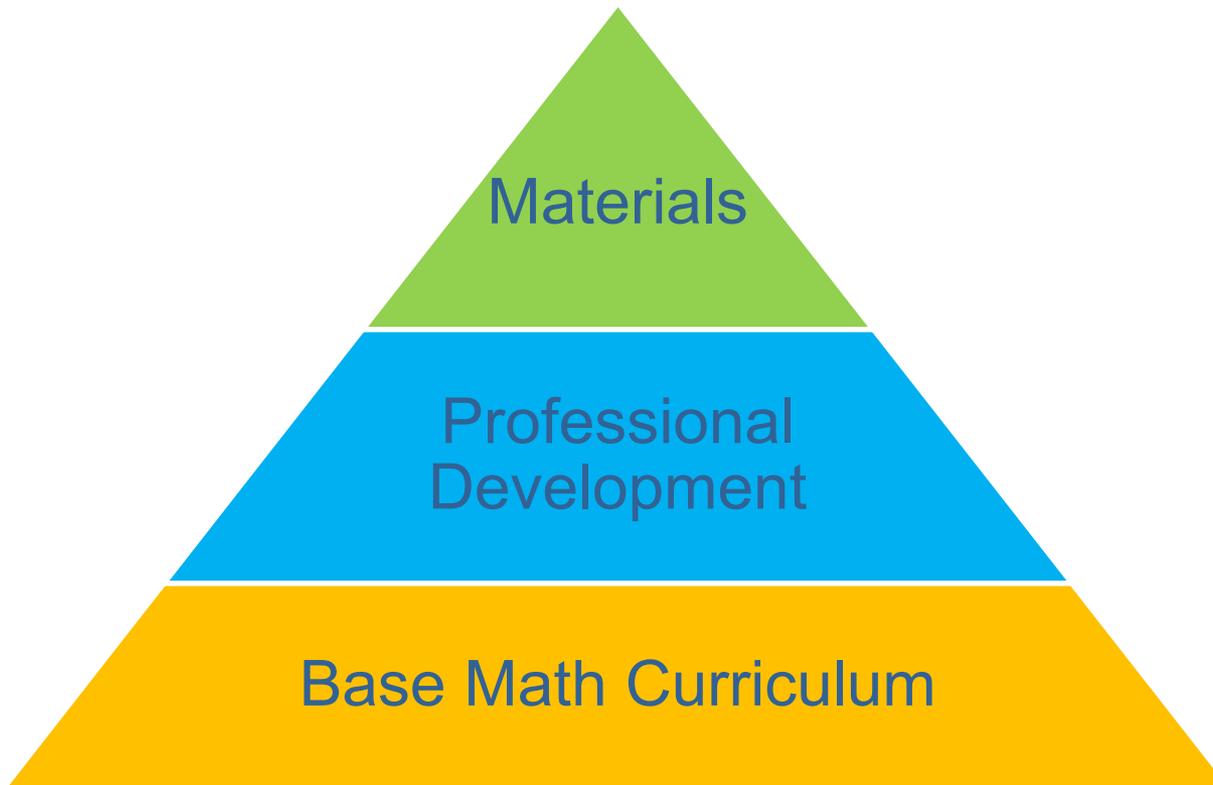
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One-day training  
prior to each unit of  
regular coaching

# What is the intervention?

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# Materials

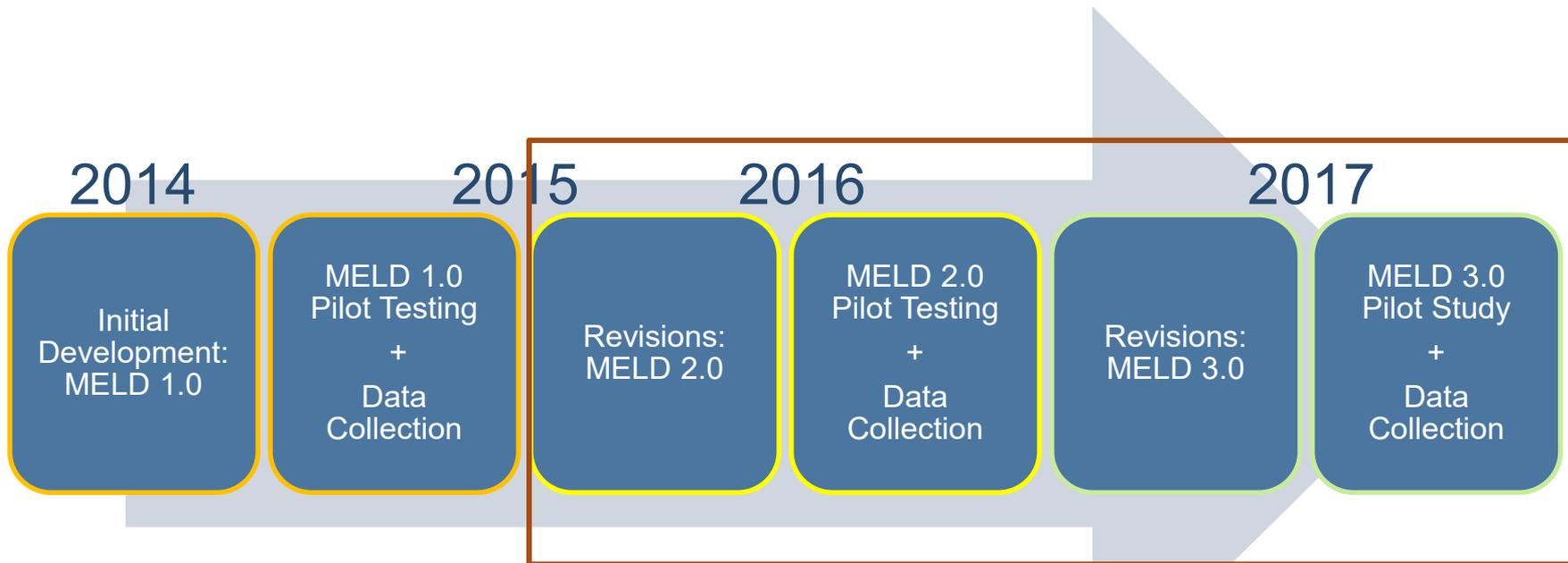
## ■ Teacher Materials

- Teacher presentation slides
  - Brief teaching notes on each slide
- Teacher guide
  - Slide by slide teaching notes
  - Answer keys

## ■ Student Materials

- Lesson and unit glossaries
- Slide by slide notes and activities (e.g., scaffolded problems)
- In class practice
- Additional practice

# Project MELD Development Timeline



**LearnZillion**

# Curricular Modification #1: Use Research-based Scaffolds and Strategies

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# Integrate Language with Content

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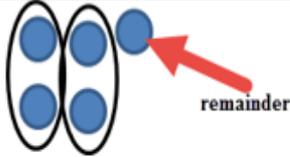
- Strategically use instructional tools—short videos, visuals, graphic organizers—to anchor instruction and help students make sense of content.
- Teach content-specific academic vocabulary as well as general vocabulary that supports it.
- Provide daily opportunities for students to talk about content in pairs and small groups.
- Provide writing opportunities to extend student learning and understanding of content material.

# Scaffold Math Content

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- Student glossaries
- Additional illustrations
- Graphic organizers
- Partner activities
- Response frames
- Worked examples
- Homework focused on academic language
- Home language support

# Student Glossary

Card number	Repeat the word	Write the word!	Listen to the definition	Listen to the example	Think-Pair-Share
5	product		the result when two or more numbers are multiplied together	$3 \times 2 = 6$ 6 is the product of 3 and 2.	What are the products in the following number statements?  1. $2 \times 3 = 6$ The product is _____.  2. $2 \times 2 = 4$ The product is _____.  3. $4 \times 5 = 20$ The product is _____.
	<i>producto</i>		<i>el resultado cuando dos o más números se multiplican juntos</i>		
6	remainder		the amount left over after solving a division problem	 $5 \div 2 = 4, R1$  5 divided by 2 is 4 with a <b>remainder</b> of 1.	What is the remainder in the following problem?  $7 \div 2 =$
	resto		<i>la cantidad que queda después de la resolución de un problema de división</i>		
21	summary		a short statement that tells the important information.	At the end of every lesson is a “Lesson Summary” where you write important information for that lesson.	Look in your student guide to find a lesson summary. Show it to your partner.
	<i>resumen</i>		<i>una frase corta que da información importante.</i>		

# Graphic Organizers

At Jack's birthday party, the ratio of chocolate cupcakes to vanilla is three to one. Write four ratios:

- chocolate to vanilla
- vanilla to chocolate
- chocolate to total
- vanilla to total



Write each ratio in three ways:

1. use the word to
2. use a colon
3. use a fraction

	chocolate to vanilla	vanilla to chocolate	chocolate to total	vanilla to total
to	3 to 1			
colon (:)				
fraction				

# Partner Activities

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- Pair ELs with limited proficiency in English with bilingual partners
- Student pairs learn five core skills to make their conversations more academic:
  - Elaborate and clarify
  - Support ideas with examples
  - Build on and/or challenge a partner's idea
  - Paraphrase
  - Synthesize conversation points

# Response Stems and Frames

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- Question: *When do we use a double number line?*
- Response Stem: *We use a double number line when we \_\_\_\_\_.*
- Question: *What do each of the number lines represent?*
- Response Frame: *In this example, the top number line represents the number of \_\_\_\_\_ and the bottom number line represents the number of \_\_\_\_\_.*

# Worked Examples

Name \_\_\_\_\_

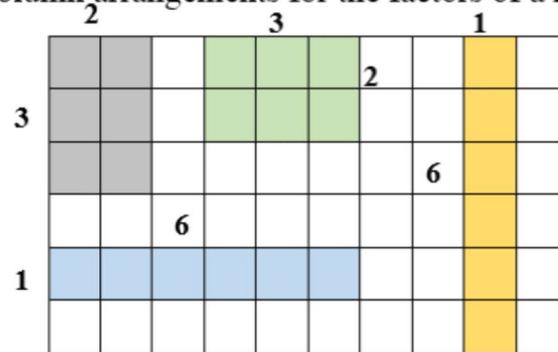
**In-class Practice**  
**Grade 6, Unit 1, Lesson 1**

Part 1 – Use the grids to show all row and column arrangements for the factors of a number.

Example: Find the factors of 6.

The rectangles show 3 rows of 2,  
2 rows of 3, 1 row of 6, and  
6 rows of 1 (don't have to draw duplicates).

The factors of 6 are 1, 2, 3, 6.

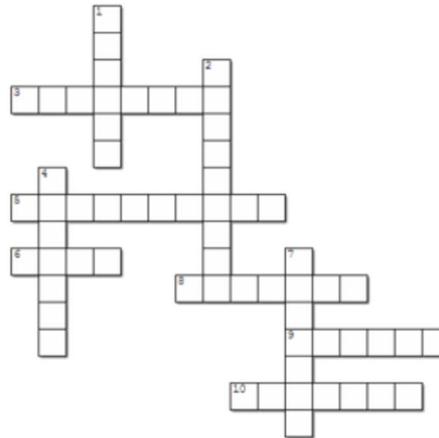


# Homework focused on academic language

Name: \_\_\_\_\_  
Teacher: \_\_\_\_\_  
Section: \_\_\_\_\_  
Date: \_\_\_\_\_

## MELD Unit 1, Lessons 1 and 2 Vocabulary Homework

**Directions:** This puzzle reviews the new vocabulary you learned in lessons 1 and 2. Read the definitions below and write the vocabulary term that matches the definition in the numbered space. If it helps you, you may use your glossary.



### Across

3. the product of a number and any natural number is a multiple of that number
5. the answer to a subtraction problem
6. to discover something
8. the result when two or more numbers are multiplied together
9. way of doing something
10. a person who works with another person

### Down

1. numbers that we multiply together
2. the amount left over after solving a division problem
4. like something else
7. a short statement that tells the important information

# Home language support

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- Bilingual student guides
- Intentional partnering
- Teacher translation

# MELD Instructional Strategies Emphasized through PD

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- Connect to students' lives to build **background knowledge**
- Use students' **L1s** strategically
- Use **checks for understanding** to assess students' emerging content and language knowledge development
- Facilitate **academic discourse** about content
- Partner ELs and non-ELs to provide **authentic opportunities for interaction**
- Support students in making written and oral **reflections** about content

# Curricular Modification #2: Build Foundational Skills

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# Build Foundational Skills

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- Teaching academic language and scaffolding content may be insufficient.
- Because of their prior educational environments, interrupted schooling, or lack of quality instruction, many middle grade ELs will also need to work on building foundational skills.

# Build Foundational Skills

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## ■ Skills focused on:

- Multiplication and division facts
- Comparing fractions
- Converting between mixed numbers and improper fractions
- Simplifying fractions
- Multiplying fractions
- Finding equivalent fractions
- Factors and multiples
- GCF and LCM
- Distributive property

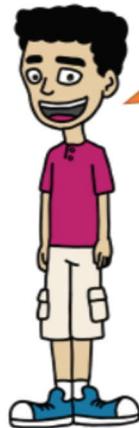
## ■ Materials:

- Supplementary lessons
- Sprints

# Supplementary Lessons

## Finding factors

- We can also find factors by dividing by natural numbers.
- Let's practice with factors of 12.
- If we divide 12 by natural numbers, we will get all of the factors of 12:
  - $12 \div 1 = 12$
  - $12 \div 2 = 6$
  - $12 \div 3 = 4$
  - $12 \div 4 = 3$
  - $12 \div 5 = 2.4$
  - $12 \div 6 = 2$
  - $12 \div 7 = 1.7$



1, 2  
are  
factors  
of 12

### Additional Practice Booster 1

#### Práctica Adicional Intensificador 1

##### Part 1

Instructions: Circle the natural numbers in each set of numbers.

##### Parte 1

Instrucciones: Circula los números naturales en cada conjunto de números.

A. -6   8.2   3    $\frac{1}{2}$    0.75   0    $3\frac{4}{5}$    10   99   11.7

B. 7   6.3   5   -5   300    $\frac{16}{5}$    0.333...   1   0.1   -1

# Sprints

Name \_\_\_\_\_

Multiply

$2 \times 1 = \underline{\quad}$     $2 \times 2 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$     $2 \times 4 = \underline{\quad}$

$2 \times 5 = \underline{\quad}$     $2 \times 1 = \underline{\quad}$     $2 \times 2 = \underline{\quad}$     $2 \times 1 = \underline{\quad}$

$2 \times 3 = \underline{\quad}$     $2 \times 1 = \underline{\quad}$     $2 \times 4 = \underline{\quad}$     $2 \times 1 = \underline{\quad}$

$2 \times 5 = \underline{\quad}$     $2 \times 1 = \underline{\quad}$     $2 \times 2 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$

$2 \times 2 = \underline{\quad}$     $2 \times 4 = \underline{\quad}$     $2 \times 2 = \underline{\quad}$     $2 \times 5 = \underline{\quad}$

$2 \times 2 = \underline{\quad}$     $2 \times 1 = \underline{\quad}$     $2 \times 2 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$

$2 \times 1 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$     $2 \times 2 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$

$2 \times 4 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$     $2 \times 5 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$

$2 \times 4 = \underline{\quad}$     $2 \times 1 = \underline{\quad}$     $2 \times 4 = \underline{\quad}$     $2 \times 2 = \underline{\quad}$

$2 \times 4 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$     $2 \times 4 = \underline{\quad}$     $2 \times 5 = \underline{\quad}$

$2 \times 4 = \underline{\quad}$     $2 \times 5 = \underline{\quad}$     $2 \times 1 = \underline{\quad}$     $2 \times 5 = \underline{\quad}$

$2 \times 2 = \underline{\quad}$     $2 \times 5 = \underline{\quad}$     $2 \times 3 = \underline{\quad}$     $2 \times 5 = \underline{\quad}$

# Curricular Modification #3: Develop Conceptual Knowledge Through Hands-on Activities

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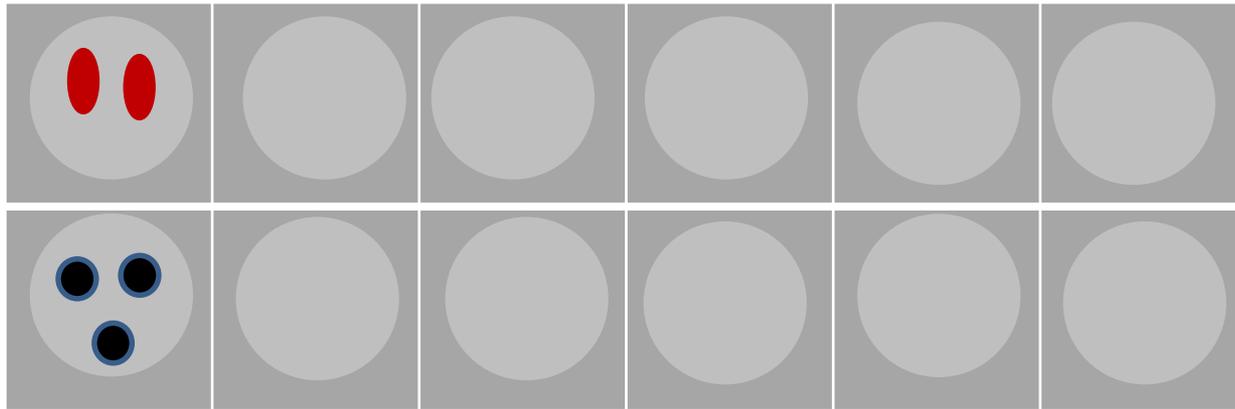
# Develop Conceptual Knowledge

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- Many ELs may need additional time to develop their conceptual knowledge in mathematics.
- Hands on activities facilitate conceptual development while not requiring a high level of academic language.
- Example: Using egg cartons and beans to develop knowledge of equivalent ratios.

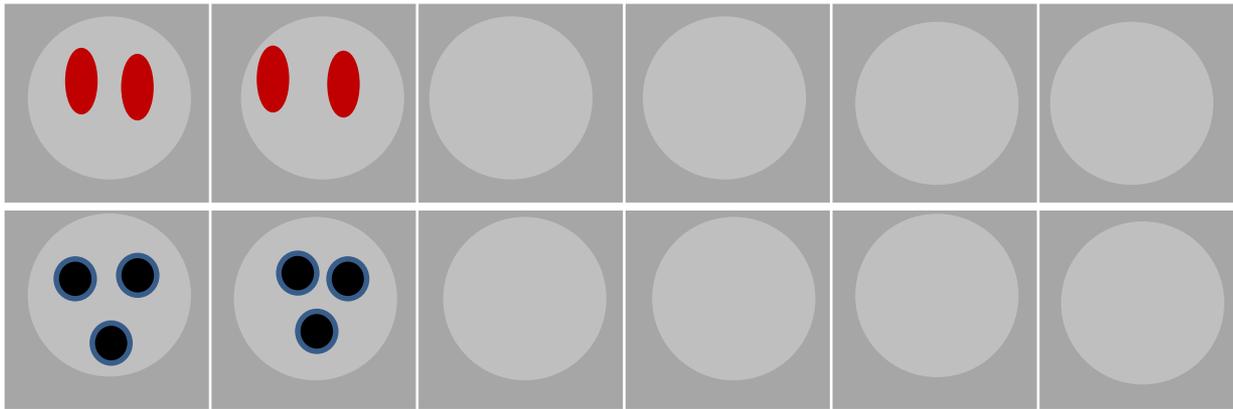


Equivalent ratios can be built using a pattern.



This ratio is 2 red to 3 black.

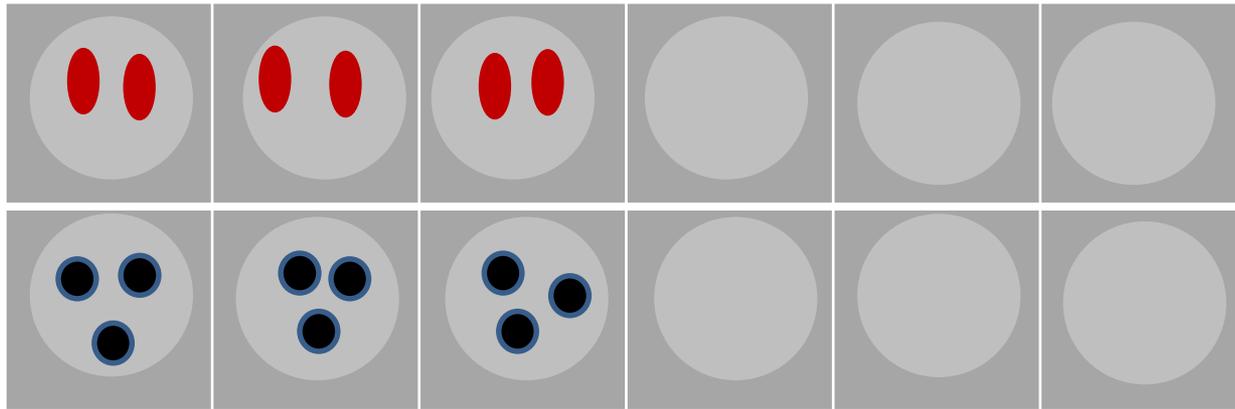
Equivalent ratios can be built using a pattern.



This ratio is equivalent to 2 red to 3 black.

If all the beans are counted it is 4 red to 6 black.

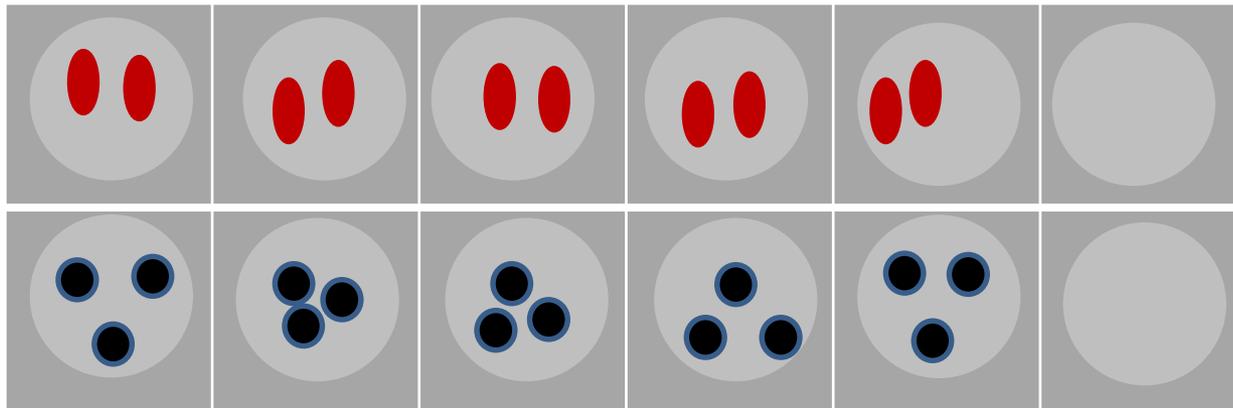
Equivalent ratios can be built using a pattern.



This ratio is equivalent to 2 **red** to 3 **black**.

If all the beans are counted the ratio is 6 **red** to 9 **black**.

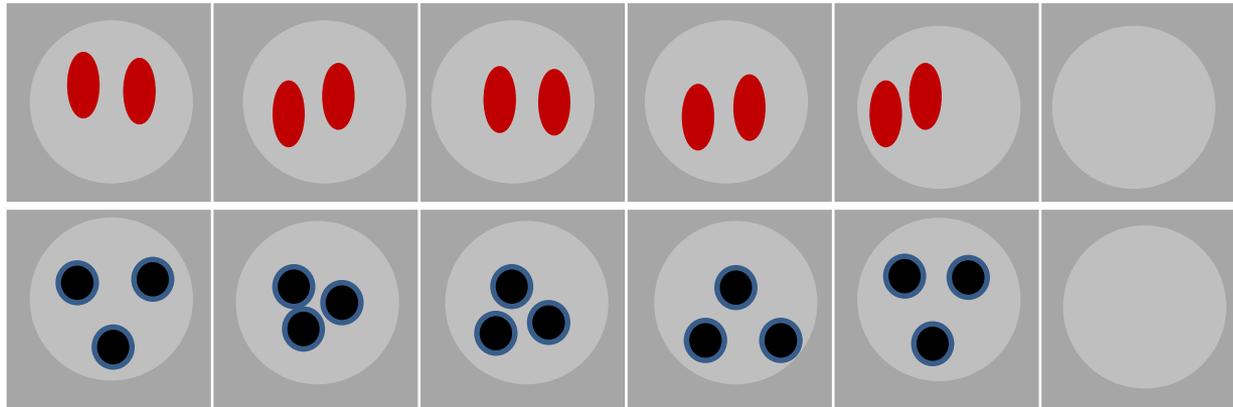
Equivalent ratios can be built using a pattern.



This ratio is equivalent to 2 **red** to 3 **black**.  
What is the ratio counting all the beans?



We can keep track with a ratio table.



<b>RED</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>10</b>	
<b>BLACK</b>	<b>3</b>	<b>6</b>	<b>9</b>	<b>12</b>	<b>15</b>	

# Pilot Study

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# Pilot Study: Context

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- Five public middle schools in the Rio Grande Valley
- District students are 85% Latino
- District students are 15% EL
- District students are 77% economically disadvantaged
- A supplemental math class for sixth grade students who had not met math benchmarks by the end of fifth grade
  - Treatment condition: MELD intervention used as the additional math class
  - Control condition: District curriculum used as the additional math class

# Pilot Study: Sample

	<b>Non-ELs</b>	<b>ELs</b>	<b>Total</b>
Fall 2017 MELD students	44	48	<b>92</b>
Fall 2017 control students	21	8	<b>29</b>
Spring 2018 control students	66	42	<b>108</b>
<b>Total</b>	<b>131</b>	<b>98</b>	<b>229</b>

# Pilot Study: District Supplement vs. MELD Supplement

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## ■ District Curriculum

- Content:
  - Fraction and decimal computation
  - Ratios
  - Percentages
- Faster pacing
- Singular methods for problem solving
- No explicit focus on academic language development

## ■ MELD Supplement

- Content:
  - Fraction and decimal computation
  - Ratios
  - Percentages
- **Slower pacing**
- **Multiple methods for problem solving**
- **Focus on academic language development**

# Pilot Study: Measures

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## ■ Treatment group:

- Math readiness
- Math assessments
- Vocabulary assessments
- Academic language
- Teacher pre- and post-surveys
- Classroom observations
- Teacher logs
- Teacher debriefs

## ■ Control group:

- Math readiness
- Math assessments
- Vocabulary assessments

# Math Item

1. Jason has 160 pencils.  
 He wants to give each friend the same number of pencils.  
 Which table shows the **relationship** between  $n$ , the number of friends he shares with, and  $p$ , the number of pencils each person gets?  
*Jason tiene 160 lápices.  
 Él quiere dar a cada amigo el mismo número de lápices.  
 ¿Qué tabla muestra la **relación** entre  $n$ , el número de amigos con los que comparte, y  $p$ , el número de lápices que cada persona obtiene?*

a

Number of People, $n$	Number of Pencils, $p$
2	80
4	40
10	16
20	8

c

Number of People, $n$	Number of Pencils, $p$
2	320
4	640
10	1,600
20	3,200

b

Number of People, $n$	Number of Pencils, $p$
10	150
20	140
30	130
40	120

d

Number of People, $n$	Number of Pencils, $p$
10	16
20	14
30	12
40	10

relation ship relación	a connection una conexión
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# Vocabulary Items

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1. \_\_\_\_\_ means the answer to a subtraction problem.

*Example: The \_\_\_\_\_ between 5 and 3 is 2.*

2. \_\_\_\_\_ means having the same value. *Example:*

$$5 \times 3 = 1 \times 15$$

3. \_\_\_\_\_ means place or space

*Example: The \_\_\_\_\_ of a triangle is the space inside of the triangle.*

**A. area**

**B. Distributive  
Property**

**C. equivalent**

**D. difference**

**E. design**

# Pilot Study: Analytic Approach

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- All models were fit using generalized linear mixed effects modeling.
- Data were modeled at the item level and a random intercept was fit for student and school.
- Item performance was predicted by wave (pre-post), treatment (MELD supplement versus district supplement); EL status, as well as the two-way and three-way interactions

# Pilot Study: Comparisons

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District  
supplement

vs.

MELD  
supplement

No  
supplement

vs.

MELD  
supplement

# Pilot Study: Results

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- ELs and English-proficient students who received MELD supplemental instruction had **statistically significant and larger gains in math and vocabulary** than their peers who received the district supplement.
- ELs and English-proficient students who received supplemental instruction using the MELD curriculum had **statistically significant and larger gains in math and vocabulary** than ELs and English-proficient students who received no supplemental math.

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