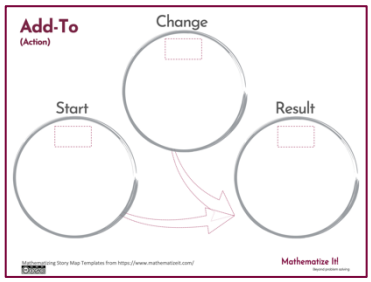
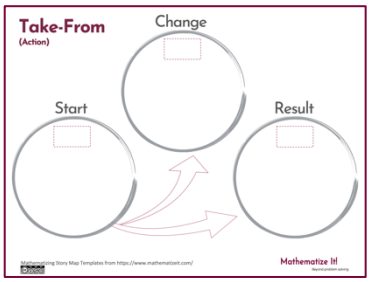
#17 On the Road to Recovery

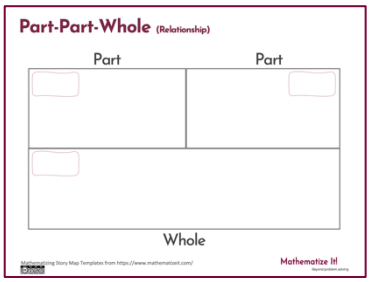
Area and Array
One Dimension
Unknown

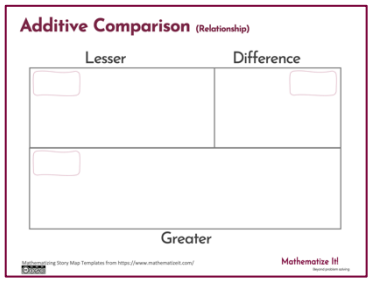
Making sense of word problems with mathematical comprehension & operation sense.

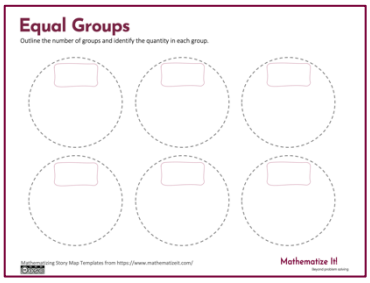
Mathematizing Story Maps

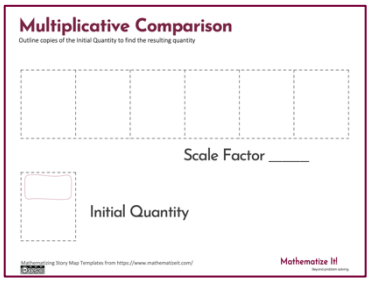


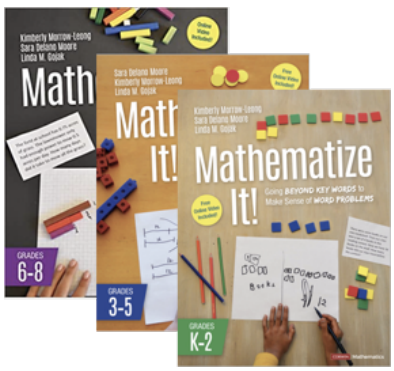


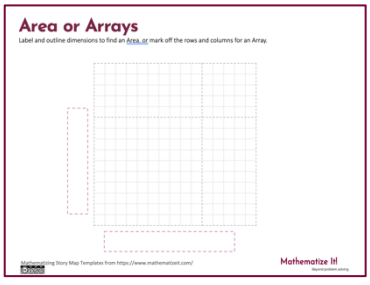


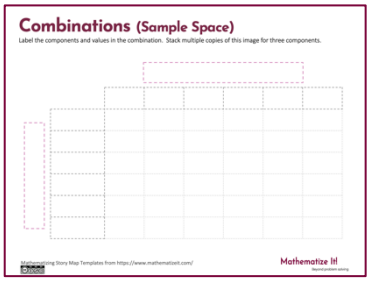










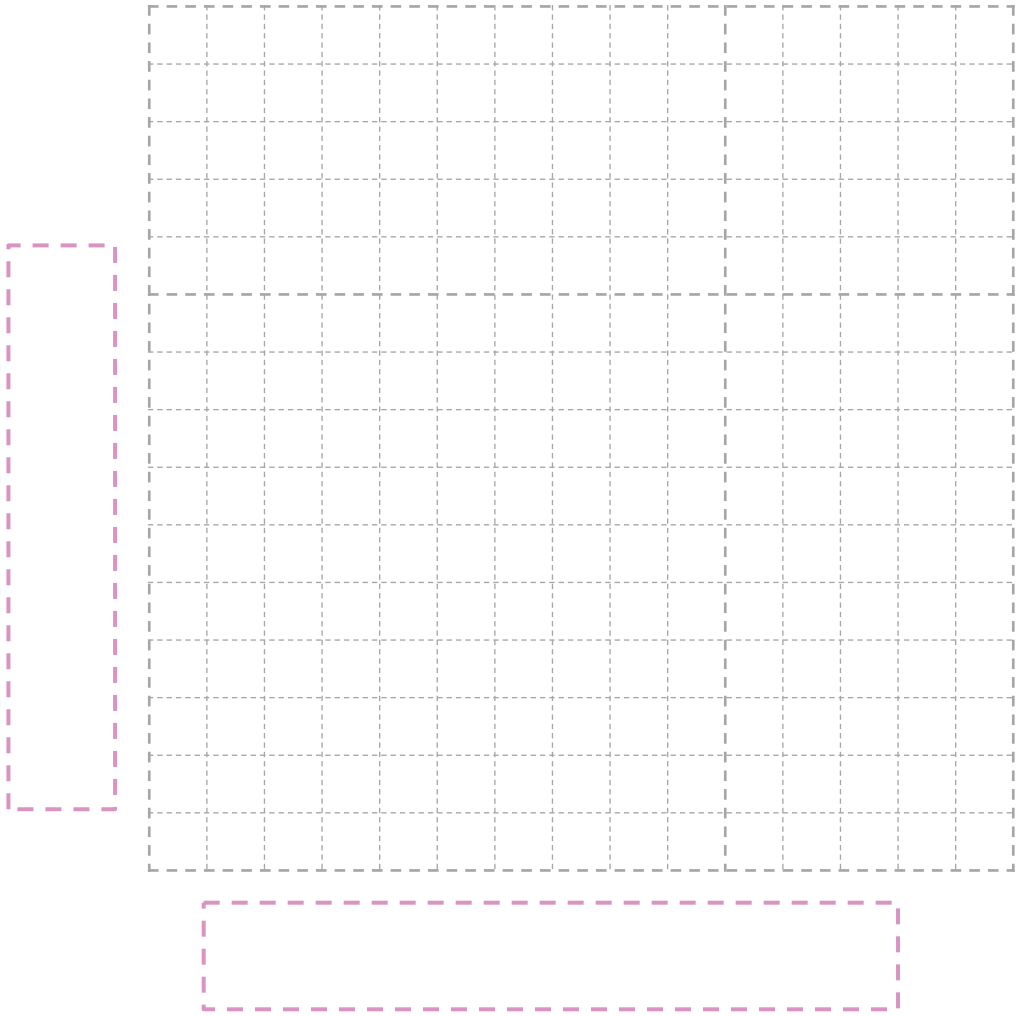


Mathematize It!

Sara Delano Moore and Kimberly Morrow-Leong
Mathematizing Story Map Templates from https://www.mathematizeit.com/

Area or Arrays

Label and outline dimensions to find an Area, or mark off the rows and columns for an Array.



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Mathematize It!
Beyond problem solving

Mathematizing Story Maps

How do your students approach word problems?

Key words don't always help. What are we supposed to underline in CUBES anyway?

Sometimes it feels like students just pick an operation and they don't know why!

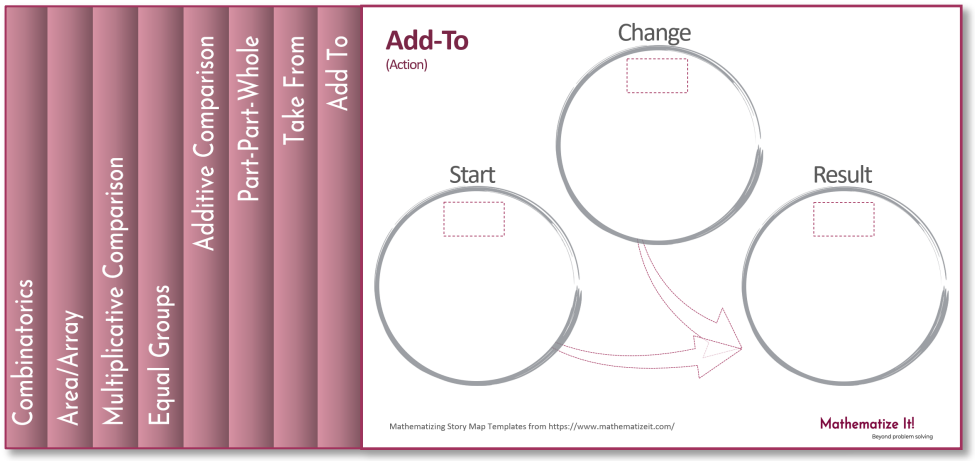
These strategies don't prepare students to formulate and solve problems that matter to them.

Prepare students to DO math!

Teacher Background

Mathematizing Story Maps encourage students to model with mathematics and find the math in their everyday lives. Opening stories are written to engage students first in thinking about the story and then about the mathematics.

Mathematizing Story Maps help students understand what the four familiar operations (+ − × ÷) can do. The more students know about how we use subtraction or when we use division, the more skills they will have to match a strategy to a problem.



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How to teach the Mathematizing Story Maps

1. **Read the story**
   a. Think about how your students might respond. What's familiar? What's not?
   b. What mathematics is seen in the story? How might students represent their thinking?
2. **Choose tools you have and that students know.**
   a. What manipulatives might your students use to represent the mathematics in the story? Consider counters, base ten materials, fraction tools, or more!
   b. What visual representations might your students know (ten frames, number tracks, number lines, grid paper, etc.)
3. **Choose a Mathematizing Story Map**
   We share a mathematizing story map for each of 8 categories of problem situations.

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Mathematizing Story Maps help students act out or represent what is happening in a problem and make sense of it.

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What will students do?

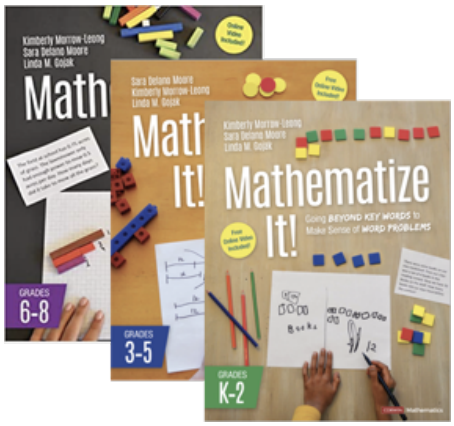
Most word problems (story problems) students encounter support their calculation skills. We need to build their understanding of how to use math to solve real problems.

- Find the story behind every mathematical problem situation
- Use one of 8 Mathematizing Story Maps to act it out or show
- Represent the story and choose an operation (+ − × ÷) that matches the story.
- Resist answer-getting. We pay attention to the process of solving problems

What's included?

Each mathematizing story map lesson includes:

- Teaching notes on 8 categories of problem situations.
- Teaching notes for the Mathematizing Story Maps
- A set of questions to pose that focus students on the mathematizing story.



To read more about problem situations and the four operations, check out the *Mathematize It!* book series.

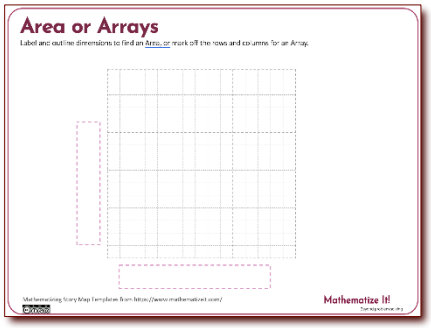
BY NC SA

Teacher Notes
Mathematizing Story Maps
On the Road to Recovery

Problem Type
This story supports developing mathematical ideas around the Area/Array work of multiplication. Area/Array problem situations may be better thought of as moving from two measures of linear dimension (feet, yard, cm, m, km) that combine to make a new unit of measure. Instead of measuring a line, as a single dimension does, area is measured with a square. An array is similar because a new unit is named where a row and column meet, yet it isn't called either of those names: it's a cell, a square, etc.. Area/Array problem situations describe the creation of something new.

Missing Element
In this story, one factor is unknown. Students know two quantities measured in different units, one factor in linear units (the length of a rectangle in centimeters, for example) and one factor in square units (area in square centimeters. For example). They must identify the unknown factor's value and unit of measure.

The Mathematizing Story Map
The Mathematizing Story Map provided supports students' understanding of Area & Array multiplication. The map shows the dimensions on each side of the array, and the number of individual squares represents the total quantity of the new (square) unit of measure. This is the product.



Multiplication & Division Problem Situations

Asymmetric Situations	**Equal Groups (Ratio/Rate)**	Product Unknown	Number of Groups (Multiplier) Unknown	Group Size (Measure) Unknown
	Multiplicative Comparison	Resulting Value Unknown	Scale Factor Unknown	Original Value Unknown
Symmetric Situations	**Area/Array**	Product Unknown	One-Dimension Unknown	Both Dimensions Unknown
	Combinatorics	Sample Space (Total Outcomes) Unknown	One Factor Unknown	Both Factors Unknown

Day 1

Read the story at least once with your class. Talk about the story and support your students as they make sense of the events in the story as you would for any narrative.

You may wish to use the Three Reads Strategy (p.15) to support student understanding of the text itself.

Then encourage students to find the mathematics in the story with questions like these:

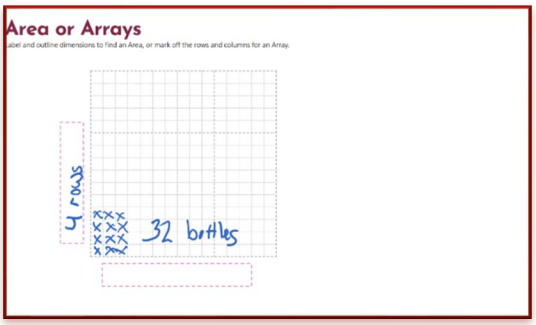
- *What are the units of measure involved in this situation?*
- *For each factor, what is the unit? What will be the unit of the product?*

If students start calculating numbers right away, particularly if they are "number-plucking" or randomly doing calculations, refocus their attention on the relationship in the story.

To focus on the story, create a numberless word problem. Remove the numbers from the story as the class discusses it.

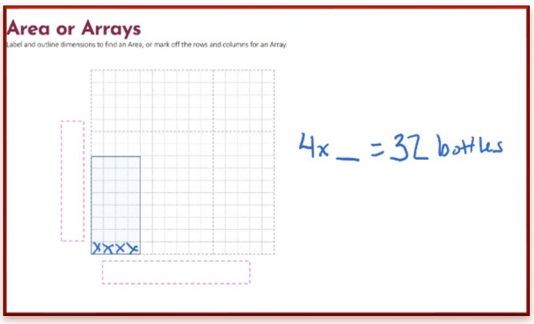
Encourage students to use manipulatives as they work on the Mathematizing Story Map to show the relationship that is in the story. Label the quantities and their units. Before ending for the day, give students the opportunity to record their thinking on paper.

Encourage students to use manipulatives and visuals to show their thinking about the math in the story. Students should translate their work from manipulatives and sketches to the mathematical story map.



Day 2

Reread the story and use the Mathematizing Story Map to retell it and act it out. Ask your students to translate their actions on the Mathematizing Story Map into an equation. Each student should be able to connect the elements of the story map to the narrative. Discuss the ***quantities*** in the story and what strategies students might use to find an answer to the question they have asked. Ask students to consider other mathematical stories (or variations on the current story) they can see in this narrative.



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Day 3

Use the mathematizing story map to support solving the word problems provided. Take time for reading comprehension (does the story make sense?) before mathematical comprehension (what is happening in the story?) These questions can help students develop mathematical comprehension.

- *What are the units of measure involved in this situation?*
- *For each factor, what is the unit? What will be the unit of the product?*

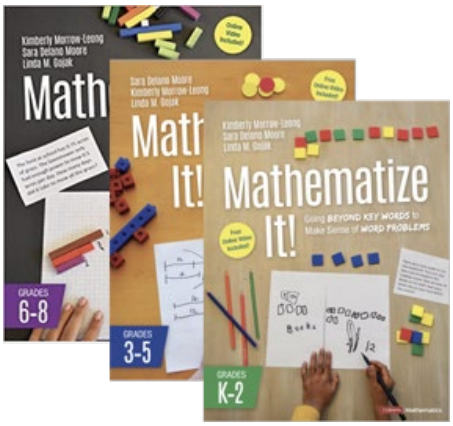
Encourage your students to use manipulatives and visuals to show their thinking about the math happening in each problem. Students should translate their work from manipulatives and sketches to the mathematical story map.

Days 4-5

Choose one or more of these options to continue developing student thinking.

- Continue working on the problems provided, focusing on the story map as a tool to develop mathematical comprehension and operation sense.
- Lead a discussion among students focusing on how the story map fits the narrative and problems provided. Use these questions to focus thinking on the job Area & Array is doing in these situations:
    - *How are the linear units of measure related to the square units of measure?*
    - *What number sentence(s) can you write to show these relationships?*
- Ask students to develop new narratives or problems, either from scratch or as extensions of the current storyline, which can also be told using the same mathematical story map. Encourage students to explain the underlying connections which make the mathematics similar even if the story contexts are not the same.

To read more about problem situations and the four operations, check out the ***Mathematize It!*** book series.



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On the Road to Recovery Practice Problems

Use objects, pictures, numbers, and words to describe what is happening in each problem. Use a mathematizing story map to record your thinking.

Tyler looked at his spreadsheet for winners and realized he had too many cells. There were only going to be 30 winners for the 5 events. How many heats would be represented in the spreadsheet for each event?

Amanda was arranging the fruit for snack time. With fruit for athletes and helpers, they had 48 pieces of fruit total. The first row had 8 pieces of fruit in it. How many rows would they need?

Carlos's sister was tired of waiting for all the events to end. She was bored, too. Carlos walked with her to the table where the prizes were being arranged so she could help set them up. There was one prize for each of the 30 winners, arranged in three long rows. How many prizes were in each row?

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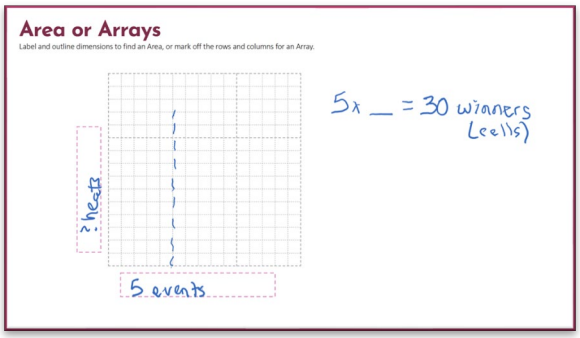

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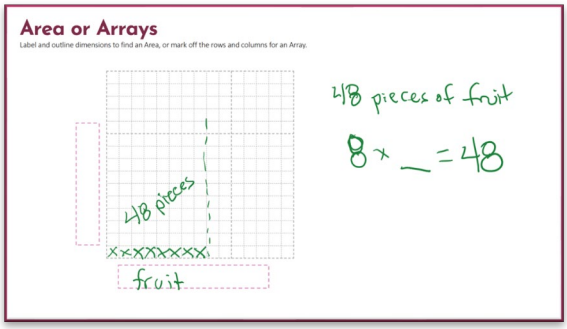

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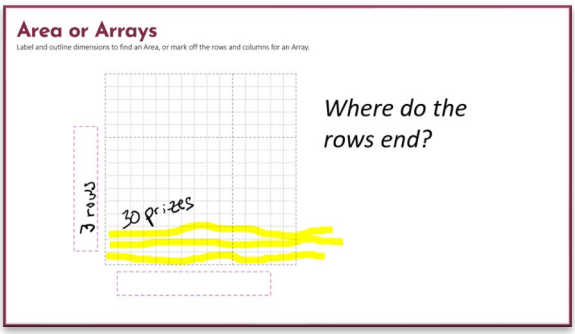

Area and Array Situations, One Dimension Unknown