PROBLEM SOLVING IN ACTION

GRADE 4

Presenter
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OVERVIEW

Learning Intention:

- Fostering higher expectations for all learners to accelerate student achievement

I can statements:

- I can participate in problem solving protocols.
- I can share strategies for teaching problem solving.

TURN AND TALK

What strategies and/or resources are you currently using to teach problem solving in your classroom?

KEY POINT

The primary goal of problem solving is

making sense of mathematics!

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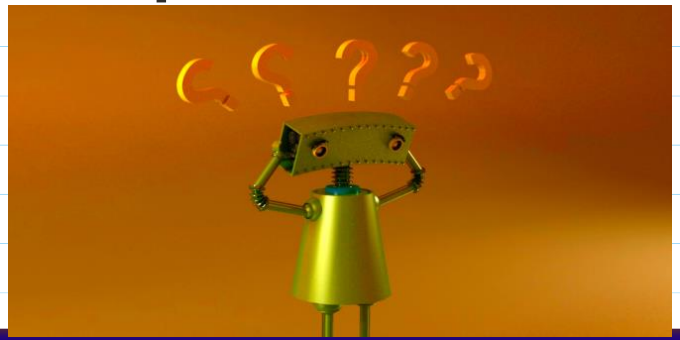
Key Words:

Key words are NOT a viable strategy for solving word problems. Instead, we want students to make sense of problems and make use of their understanding to solve the problems. Moreover, research tells us that the use of key words as a strategy for solving problems adds to our students' inability to solve problems.



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MATHEMATICAL PROCESS STANDARD #1

Make sense of problems and persevere in solving them.

a. Relate a problem to prior knowledge.
b. Recognize there may be multiple entry points to a problem and more than one path to a solution.
c. Analyze what is given, what is not given, what is being asked, and what strategies are needed, and make an initial attempt to solve a problem.
d. Evaluate the success of an approach to solve a problem and refine it if necessary.

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WHAT DOES IT LOOK LIKE WHEN STUDENTS MAKE SENSE OF PROBLEMS?

https://www.youtube.com/watch?v=kibaFBgaPx4

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MATH SCCCR STANDARDS GRADE 4

4.ATO.2 Solve real-world problems using multiplication (product unknown) and division (group size unknown, number of groups unknown).

4.ATO.3 Solve multi-step, real-world problems using the four operations. Represent the problem using an equation with a variable as the unknown quantity.

4.MDA.2 Solve real-world problems involving distance/length, intervals of time within 12 hours, liquid volume, mass, and money using the four operations.

4.MDA.7 Solve addition and subtraction problems to find unknown angles in real-world and mathematical problems.

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Types of Problems (+, -)

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Common Addition and Subtraction Problem Types

	Result Unknown	Change Unknown	Start Unknown
Add to/ Joining	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? 2 + 3 = ?	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? 2 + ? = 5	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? ? + 3 = 5
Joining action-involves three quantities; an initial amount, a change amount (the part being added or joined), and the resulting amount (the amount after the action is over).			
Take From/ Separating	Five apples were on the table. I ate two apples. How many apples are on the table now? 5 – 2 = ?	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? 5 - ? = 3	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? ? – 2 = 3
Separation action involves three quantities; the initial amount as the whole or the largest amount, a change, and result amounts.			
	Total Unknown	**Addend Unknown**	**Both Addends Unknown**
Part-Part- Whole	Three red apples and two green apples are on the table. How many apples are on the table? 3 + 2 = ?	Five apples are on the table. Three are red and the rest are green. How many apples are green? 3 + ? = 5, 5 – 3 = ?	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? 5 = 0 + 5, 5 = 5 + 0 5 = 1 + 4, 5 = 4 + 1 5 = 2 + 3, 5 = 3 + 2
Part-Part-Whole action-involves two parts that are combined into one whole. There is no meaningful distinction between the two parts within a part-part-whole situation, so there is no need to have a different problem for each part as the unknown.			
	Difference Unknown	**Bigger Unknown**	**Smaller Unknown**
Compare	**("How many more?" version):** Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? **("How many fewer?" version):** Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? 2 + ? = 5, 5 – 2 = ?	**(Version with "more"):** Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? **(Version with "fewer"):** Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? 2 + 3 = ?, 3 + 2 = ?	**(Version with "more"):** Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have? **(Version with "fewer"):** Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? 5 – 3 = ?, ? + 3 = 5
Compare problems involve the comparison of two quantities, and the third amount is the difference between the two amounts. (Adapted from Van de Walle)			

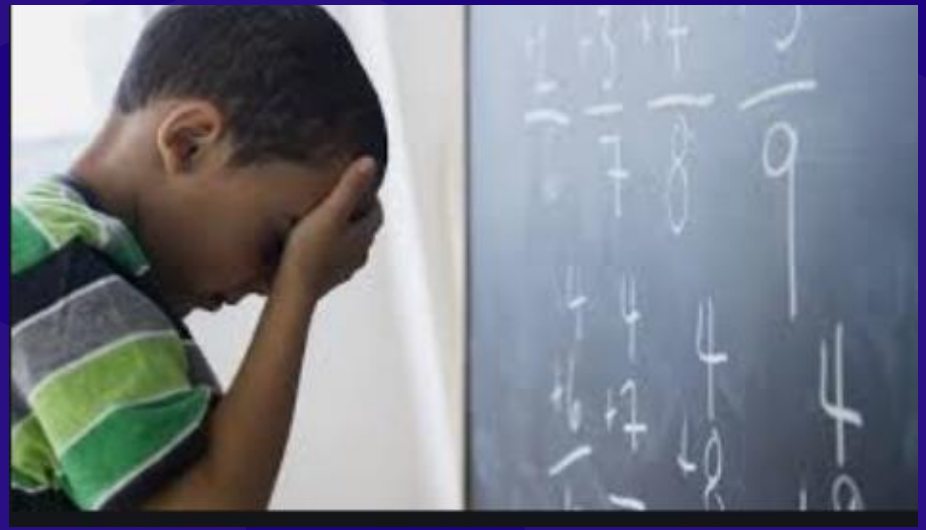
Types of Problems (x, ÷)

Common Multiplication and Division Problem Types

	Unknown Product 3 x 6 = ?	Group Size Unknown "How many in group?" Division 3 x ? = 18, and 18 ÷ 3 = ?	Number of Groups Unknown "How many groups?" Division ? x 6 = 18, and 18 ÷ 6 = ?
Equal Groups	There are 3 bags with 6 plums in each bag. How many plums are there in all? ***Measurement example:*** You need 3 lengths of string, each 6 inches long. How much string will you need altogether?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? ***Measurement example:*** You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? **Measurement example:** You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
Arrays, Area	There are 3 rows of apples with 6 apples in each row. How many apples are there? ***Area example:*** What is the area of a 3 cm by 6 cm rectangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? ***Area example:*** A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples, how many rows will there be? ***Area example:*** A rectangle has area 18 square centimeters. If one side is 6 cm long, how long is a side next to it?
Compare	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? ***Measurement example:*** A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? ***Measurement example:*** A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? ***Measurement example:*** A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
General	a x b = ?	a x ? = p, and p ÷ a = ?	? x b = p, and p ÷ b = ?

- The first examples in each cell are examples of discrete things. These are easier for students and should be given before the measurement examples.
- The language in the array examples shows the easiest form of array problems. A harder form is to use the terms rows and columns. Both forms are valuable. **Harder Array** The apples in the grocery window are in 3 rows and 6 columns. How many apples are in there?
- Area involves arrays of squares that have been pushed together so that there are no gaps or overlaps, so array problems include these especially important measurement situations.

MANY STUDENTS THINK WORD PROBLEMS ARE HARD!



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Why are word problems so hard?

Issue #1: Reading Levels (Student's Level)

"...mathematics text contain more concepts per sentence and paragraph than any other type of text. They are written in a very compact style; **each sentence contains a lot of information**, with little redundancy."

- Barton & Heideman, 2002

Why are Word Problems so Hard?

Issue #2: Answer-Getting Mind Sets

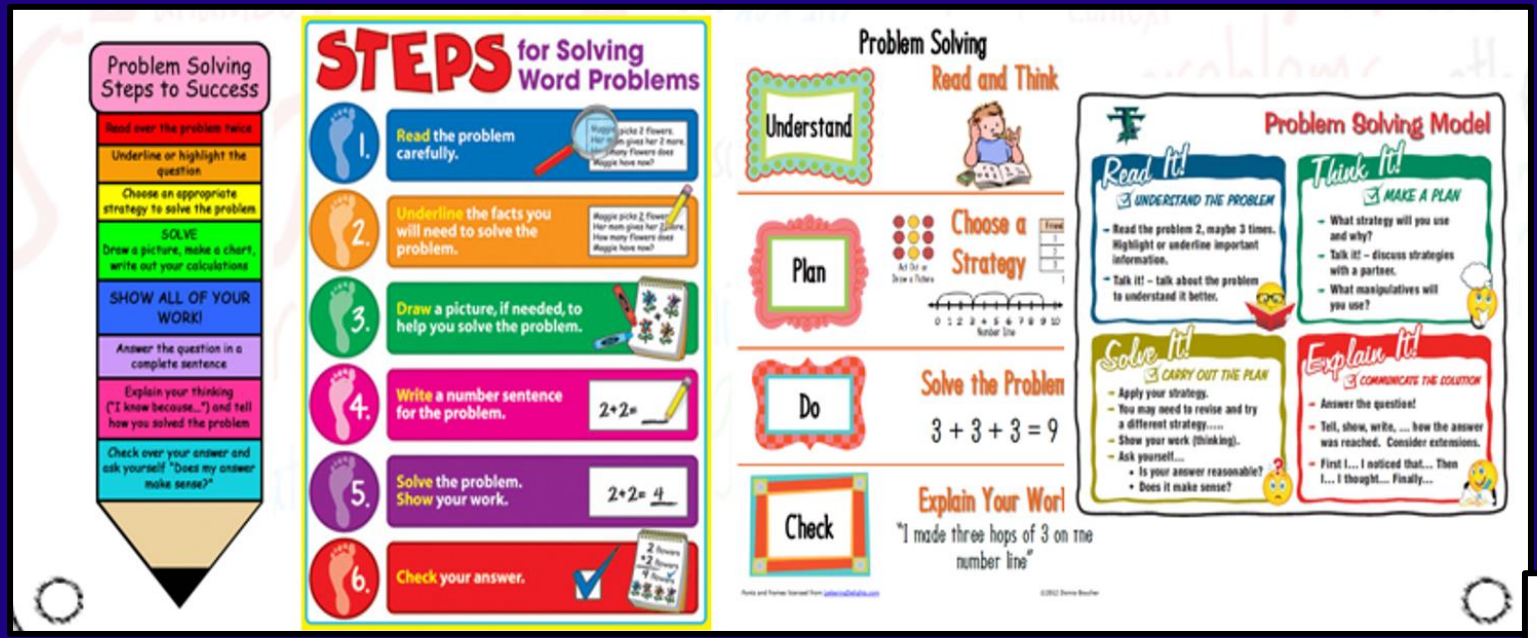
Phil Daro says...

Why give students problems to solve?

1. **To learn mathematics!**
2. Answers are part of the process, they are not the product.
   - The product is the student's mathematical knowledge and know-how.
   - The "correctness" of the answers is only part of the process.

Why are Word Problems so Hard?

Issue #3: Over simplification of the problem solving process



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KEY MESSAGE

The teacher's role as facilitator is crucial in the delivery of an effective problem-solving experience.

So what can we do?

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DISTRICT PROBLEM SOLVING PROTOCOL

Mathematics Problem-Solving Protocol

3-5

R

READ

READ the problem carefully.

I

ILLUSTRATE

DRAW a picture, diagram, or use a manipulative.

S

SOLVE

USE your math strategies.

E

EXPLAIN

JUSTIFY your answer.

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So what can we do?

1. Assess where students 'break-down' when problem solving
2. Select a manageable and achievable goal(s) or focus area(s)
3. Implement research-based strategies to address and target areas of challenge
4. Assess and celebrate progress

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STRATEGY #1 3 READ PROTOCOL

- 1st Read: Read for key ideas. (understanding)
- Students read or listen to the problem to understand the math.

No pencils…

3 READ PROTOCOL

- 2nd Read: Read to understand the math.
- Students read to make sense of what is happening. What are some of the numbers represented in the problem? What do the numbers mean?

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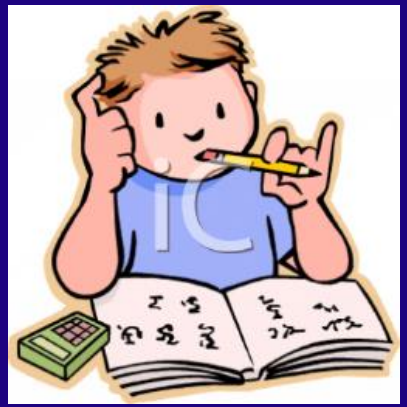
3 READ PROTOCOL

- 3rd Read: Read to make a plan.
- Students read to make a plan on solving the problem. What is the question? How can I solve this problem? Are there manipulatives that I can use?



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3 READ PROTOCOL IN ACTION

SAMPLE PROBLEM: Mr. Smith teaches a karate class every Monday at 4:00 p.m. Initially, 26 students registered for his class. Last week, 2 students withdrew from the class on Monday, 4 students withdrew from the class on Tuesday, and 3 new students registered for the class on Friday. What is the total number of students Mr. Smith currently has registered for his class?

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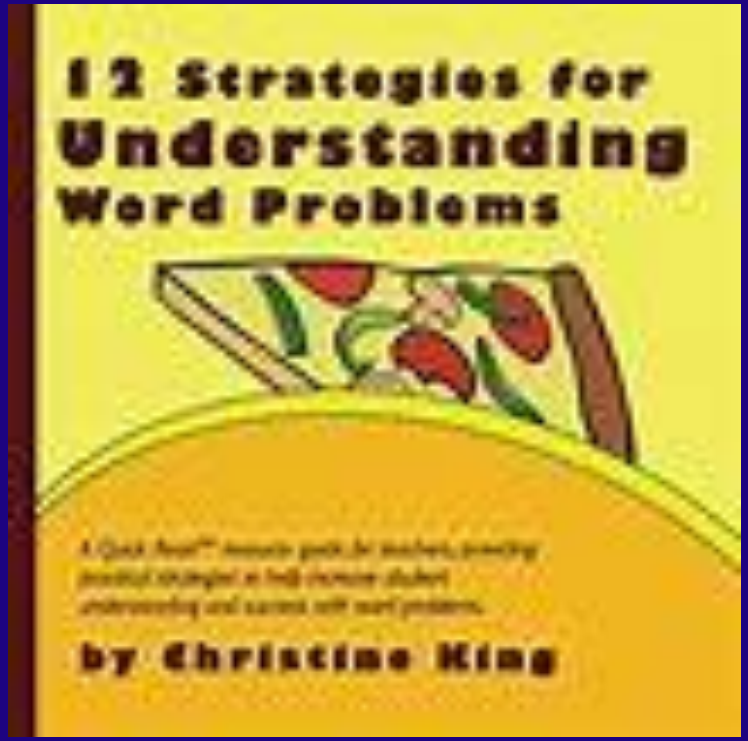
THINK-PAIR-SHARE

- What are some benefits of a 3 Read Protocol in a math classroom?

12 STRATEGIES FOR UNDERSTANDING WORD PROBLEMS

By Christine King



- Word Problem Puzzle
- A Line at a Time
- What is the Question

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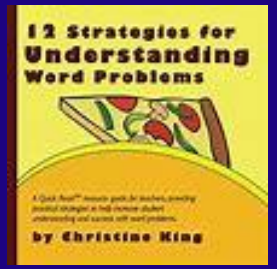
WORD PROBLEM PUZZLE



#1 Word Problem Puzzle

Task:

1. I. A word problem is cut apart as separate sentences into strips of paper.
2. Students have to put the strips in the correct order.
3. Students then solve the problem.

Put this word problem in order.

Tina has 6 fewer pieces of candy than Tony.

Tina also has some Skittles.

How many pieces of candy does Tina have?

Tony has 18 Skittles.

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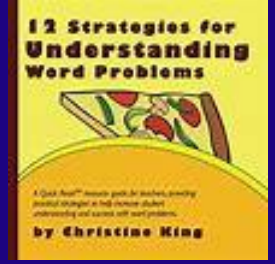

WORD PROBLEM PUZZLE IN ACTION

After paying for her food and other expenses she ended up saving $100 each week.

At her job, she made $14 an hour and she worked 12 hours each week.

How many weeks will it take Tiffany to save $300?

Tiffany was trying to save up $300 to buy a new TV.

THINK-PAIR-SHARE

- What are some benefits of using Word Problem Puzzle Protocol?

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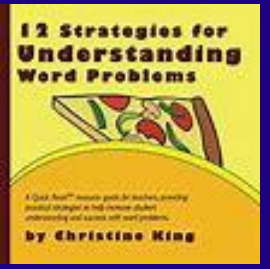
A LINE AT A TIME



- Word problems are revealed one sentence at a time. As each line is revealed have students discuss and visualize the information and how that information connects to what they already know.

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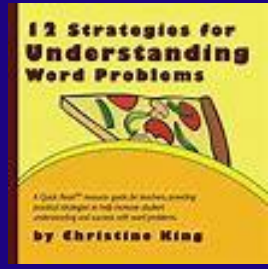
A LINE AT A TIME IN ACTION



There are 32 students in a 4th grade math class.

Visualize

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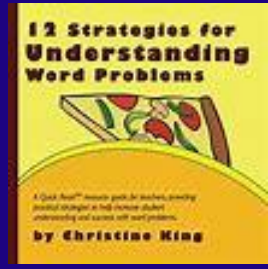
A LINE AT A TIME



Each table in the classroom seats 6 students.

Visualize

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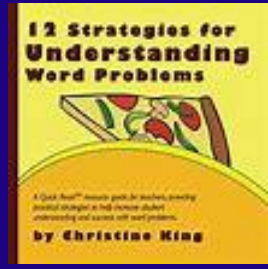
A LINE AT A TIME



How many tables will be needed?

Visualize

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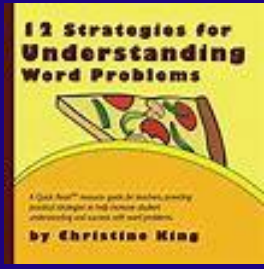
A LINE AT A TIME



There are 32 students in a 4th grade class. Each table in the classroom seats 6 students. How many tables will be needed?

Visualize

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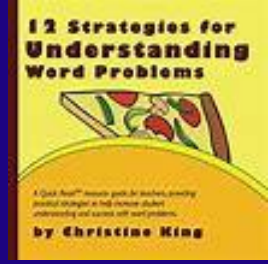
A LINE AT A TIME IN ACTION



On Monday Sam spent $\frac{1}{4}$ hours studying for his math test. On Tuesday he spent another $\frac{1}{4}$ hours studying. What is the combined time he spent studying?

Visualize

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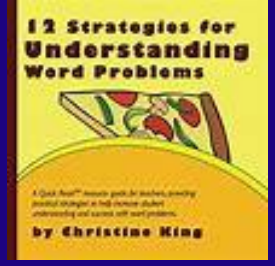
A LINE AT A TIME IN ACTION



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Visualize

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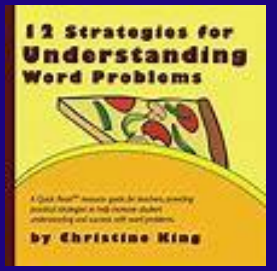
A LINE AT A TIME IN ACTION



On Tuesday he spent another $\frac{1}{4}$ hours studying.

Visualize

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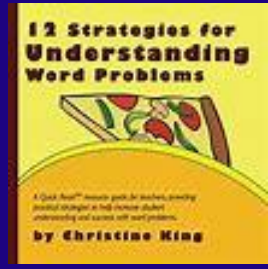
A LINE AT A TIME IN ACTION



What is the combined time he spent studying?

Visualize

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THINK-PAIR-SHARE

- What are some benefits of A Line At A Time Protocol?

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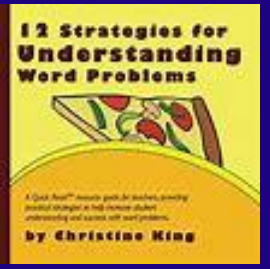
WHAT IS THE QUESTION?



- Take a word problem and remove the question. Students have to come up with questions that could be answered based upon the context or situation.

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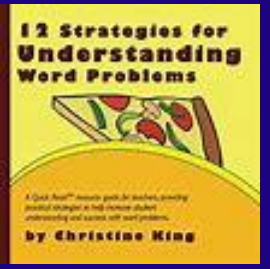
WHAT IS THE QUESTION

Melissa went to the Black Friday sale at Wal-Mart. They had microwaves for $49, flat screen tv's for $139, bicycles for $79, and Nintento for $149. Melissa's mom gave her $75 dollars to spend. Her dad gave her $125 dollars to spend.



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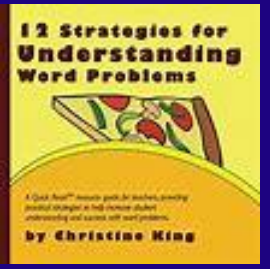
WHAT IS THE QUESTION

MENU

Turkey sandwich	$0.75
Ham and cheese sandwich	$1.60
Potato salad	$0.80
Lemonade	$0.90
Milk	$0.85



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THINK-PAIR-SHARE

- What are some benefits of using What is the Question Protocol?

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GRAPHIC ORGANIZERS & PROBLEM SOLVING

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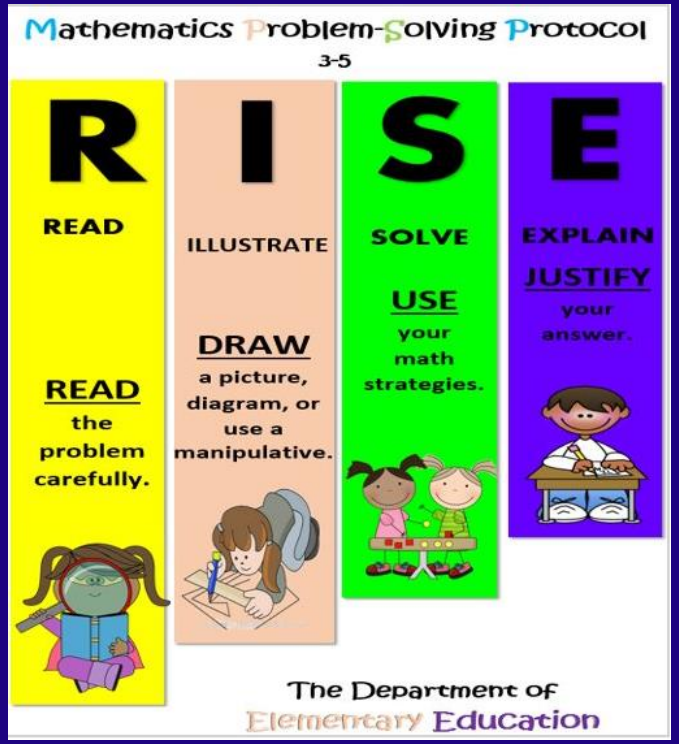
RISE



READ	ILLUSTRATE
Read the problem carefully	Draw a picture, diagram or use a manipulative.
SOLVE	**EXPLAIN**
Use your math strategies.	Justify your answer.

RISE

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Two Step Graphic Organizer

Anna bought 3 packs of stickers. Each pack had 5 stickers. Then Anna's friend gave her 10 more stickers. How many stickers does Anna have now?

Name _____

Two Step Template

My First Step	
Show It	**Equation**

My Second Step	
Show It	**Equation**

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Think-Pair-Share

- How can graphic organizers help students' problem solve?
- Are there other graphic organizers that your school is currently using to help with problem solving?

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When children practice effective problem-solving strategies, they reap many benefits:

- apply, understand and practice skills in context;
- collaborate with others to develop new strategies;
- formulate and test their own explanations;
- communicate their explanations and listen to others' explanations;
- use flexible representations to help them solve problems.

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HOW DO WE FIND ADDITIONAL PROBLEM-SOLVING TASKS FOR STUDENTS?

All K-5 Math units include at least 1 problem solving task.

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TAKE A MOMENT TO THINK ABOUT YOUR EXPERIENCE TODAY. CHOOSE ONE DISCUSSION STARTER TO SHARE YOUR THOUGHTS.

Discussion starters
I think…
It reminds me of...
I predict…
I noticed…
I like…

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Contact Information

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