Arizona Common Core State Standards
"Read Like a Mathematician"

E²Math

Literacy Resource Guide
2013-2014

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What Is Close Reading?

Close reading is a purposeful, critical analysis of a text that focuses on significant details or patterns in order to develop a deep, precise understanding of the text's form, craft, and meanings. It is a key requirement of the Common Core State Standards and directs the reader's attention to the text itself.

Close reading includes:

- Using short passages and excerpts
- Diving right into the text with limited pre-reading activities
- Focusing on the text itself
- Rereading deliberately
- Reading with a pencil
- Noticing things that are confusing
- Discussing the text with others
    - Think-Write-Pair-Share, Talk with Your Neighbor, or Pivot A-B
    - Numbered Heads
    - Timed round-robin
    - Small groups and whole class
- Responding to Text Dependent Questions

What Makes a Text Complex?

Close reading should occur with appropriately complex texts. There are a number of factors that contribute to text complexity. Teachers should differentiate, or vary, how they approach a text with students depending on the text complexity and students' needs.

- Vocabulary
  - *Academic and domain-specific terms*
  - *Tier 2 vocabulary*: high utility complex words that can be used in multiple contexts (see page 5)

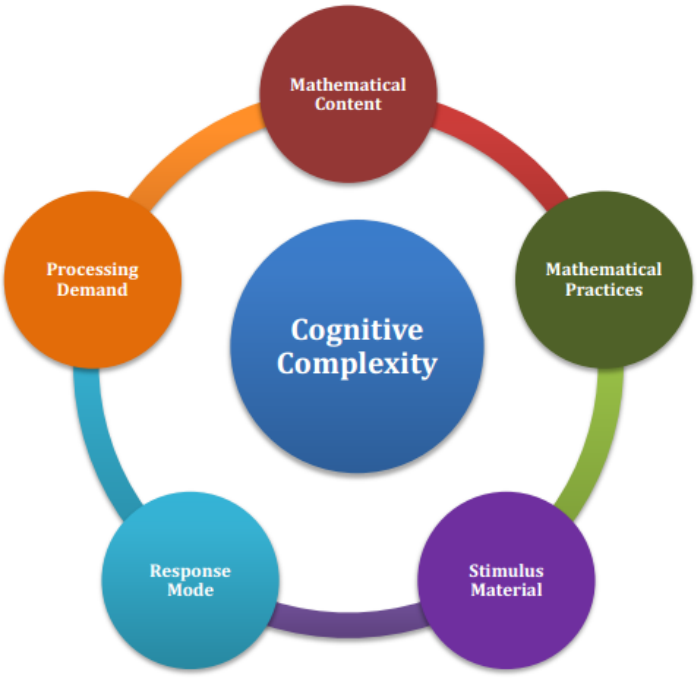
- Syntax
  - *Coherence*—Are the events and concepts logically connected and clearly explained?
  - *Unity*—Do the ideas focus on the topic and not include irrelevant or distracting information?
  - *Audience appropriateness*—Does the text match the background knowledge of the target reader?

- Text structures
  - *Description*
  - *Compare and Contrast*
  - *Temporal Sequence*
  - *Cause and Effect*
  - *Problem and Solution*

- Text features
  - *Headings/subheadings*
  - *Signal words*

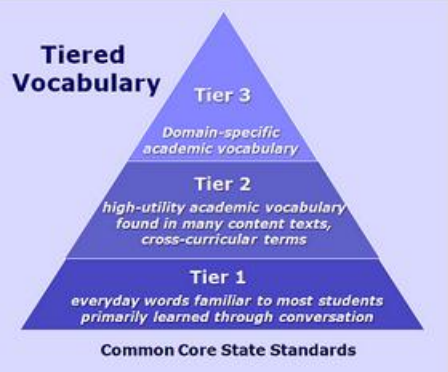
PARCC cognitive complexities for Mathematics include text complexity in calculating the cognitive complexity of math tasks. Reading load and linguistic demands in item stems, instructions for responding to an item, and response options contribute to the cognitive complexity of items (Response Mode).

Linguistic demands include vocabulary choices, phrasing, and other grammatical structures contribute to the complexity and cognitive load of processing, understanding, and formulating responses to PARCC assessment items and tasks.



Top 20 Tier 2 Vocabulary Words for Math

Tier 2 words include frequently occurring words that appear in various contexts and topics and play an important role in verbal functioning across a variety of content areas. These are general academic words and have high utility across a wide range of topics and contexts.



Another way to think of Tier 2 vocabulary is as cross-curricular terms. For example, the term *"justify" and "predict"* frequently appear in Science, Social Studies, and English texts.

Here is a comprehensive list of the Tier 2 and Tier 3 vocabulary words in the Common Core.
http://www.marzanoresearch.com/media/documents/reproducibles/vocab-common-core/sourcelistforpartIIandIIIterms.pdf

Analyze (evaluate each part)

Compare (to liken)

Contrast (find differences)

Demonstrate (prove, explain)

Describe (depict, illustrate, tell)

Argument (line of reasoning)

Conclusions (an argument deduced from evidence, inferences)

Evidence (signs, proofs, facts)

Determine (decide)

Develop (explain, elaborate)

Evaluate (assess)

Explain (clarify, describe)

Identify (recognize, find, label)

Infer (deduce, conjecture)

Draw (describe, show)

Distinguish (identify differences)

Suggest (imply)

Interpret (read between the lines)

Organize (arrange, systematize)

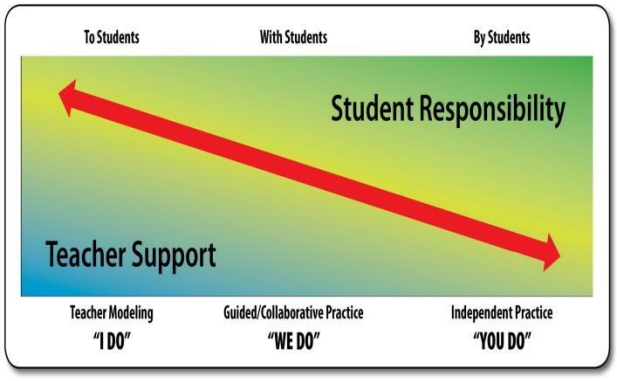
Illustrations (examples, instances)

Scaffolding Students to Read like a Mathematician

While the goal for students is to read complex texts and mathematical tasks independently, not all students will be able to achieve this immediately. Scaffolding instruction is a model in which the teacher supports students and gradually releases responsibility to the student. Pearson and Gallagher (1983) coined this term based on the 1970's work of Vygotsky. A key model in scaffolding instruction is the Gradual Release of Responsibility. In this model, the teacher begins by modeling, offering students the highest level of support. As instruction continues and the teacher monitors students' learning progress, the teacher gradually releases responsibility to the students, guiding students' progress and eventually observing as students practice the skill independently.

These teaching methods promote critical thinking:

- *Key Ideas / Supporting Details*
- *Marking the Text*
- *Shared reading*
- *Interactive read aloud*
- *QAR (Question Answer Relationships)*
- *Frayer Model*
- *Goals and givens*
- *Reciprocal Reading*
- *Think sheets*
- *Sticky Notes*
- *Jigsaws*



Whole - Pair - Solo

For students who are struggling, you may support them through a Think-Aloud, reading the text to the students and modeling your thinking and processing as a mathematician. As students become more proficient in reading, discussing, and analyzing mathematical tasks, you may gradually release the responsibility for reading and thinking to them. The idea is to offer just the right amount of support so that students can be successful.

Literacy Strategies in a Math classroom

Mathematics has a reading protocol all its own, and just as we learn to read literature, we should learn to read mathematics. Reading mathematics text demands that readers use additional, content-specific reading skills. Most texts generally include lots of information in a short amount of text. Sentences and words have precise meaning and connect logically to surrounding sentences and graphic images (table, graphs, and pictures). Mathematics also requires students to be proficient at decoding not only words but also numeric and nonnumeric symbols.

Teaching reading in in a math classroom is not so much about teaching students basic reading skills as it is about teaching students how to use reading as a tool for thinking, reasoning, and learning. Students need to construct mathematical knowledge to create their own meaning of the mathematics they encounter. Reading like a mathematician assists with acquiring mathematical expertise in a durable and useable form.

The ultimate goal of any mathematics program is to improve students' performance at solving problems correctly. The specific goals of problem-solving in Mathematics are to:

1. Improve students' willingness to try problems and improve their perseverance when solving problems. *Mathematical Practice 1*
2. Improve students ' self-concepts with respect to the abilities to solve problems.
3. Make students aware of the problem-solving strategies.
4. Make students aware of the value of approaching problems in a systematic manner.
5. Make students aware that many problems can be solved in more than one way.
6. Improve students' abilities to select appropriate solution strategies.
7. Improve students ' abilities to implement solution strategies accurately.
8. Improve students ' abilities to get more correct answers to problems.

The following pages include 4 specific strategies to develop the role of the reader in a mathematics classroom. There are several other strategies that can be employed and this list is not exhaustive.

Goals and Givens	**Reciprocal Reading**
Frayer Model for Vocabulary	**Problem Solving Template**

Close Reading using **Goals and Givens**

Purpose

To actively engage students to make meaning while solving math problems.

Rationale

Goals and Givens is an active reading strategy that asks students to identify information in the text that is relevant to solving the mathematical task. When students read through tasks purposefully, they are actively engaged in meaning making. To create an effective problem solving strategy, students must evaluate the entire task and begin to recognize and isolate key information. Once the information is identified, students will be able to quickly reference information that pertains to the mathematical task.

Procedure

Read the mathematical task before giving it to your students to read. If it is a task they cannot write on, make copies for them.

Step 1

First read of the Task

❶ What is the author asking me to do? On the left side of the problem, write in your own words what are the GOALS of the task. (Paraphrase)

Step 2

Second read of the Task

❷ ***Circle Key Terms***

To help identify a **key term**, consider if the word or phrase is…

…repeated
…defined by the author
…used to explain or represent an idea
…used in an original (unique) way
…a central concept or idea
…relevant to solving the task

Step 3

Third read of the Task

❸***Highlight*** ***or*** ***Box*** ***the Vocabulary Terms or Phrase You Do Not Know***

Step 4

Fourth read of the task

❹Create a *t*-chart and state the *Goals and Givens*. What information is given to assist with solving the problem?

Goals	***Givens***

Goals and Givens (continued)

Step 5 ***Develop a Plan***

Develop a plan to reach the goal. Students will list what strategy they will utilize to solve the problem.

Step 6 ***Implement the Plan and find the solution***

Step 7 ***Check the Reasonableness of the Solution***

Reciprocal Reading

Directions: As you read a word problem, you and your partner will use the Reciprocal Reading process to identify the unknown for the problem, write down what you need to do to solve the problem, show the computations and the answer for that problem, and write down any terms or phrases that you are unfamiliar with.

	Student A	**Student B**
Step 1	Reads aloud or silently.	Listens to reading &/or reads silently.
Step 2	Clarifies any key term or phrase..	Clarifies any key term or phrase
Step 3	Summarizes the unknown from the problem	Verifies unknown.
Step 4.	Explains the steps and how to solve the word problem.	Verifies the solution pathway.
Step 5	Explain the answer and describe how it is reasonable.	Verify that the answer is reasonable.

Switch Roles.

Each student writes down information obtained from activity.

Page # _____ Problem # _____

Clarification	
Summary (unknown / estimate an answer)	
Computation (solve the problem)	*Explain steps to solve problem*
Reasonableness	

Name _____
PD _____

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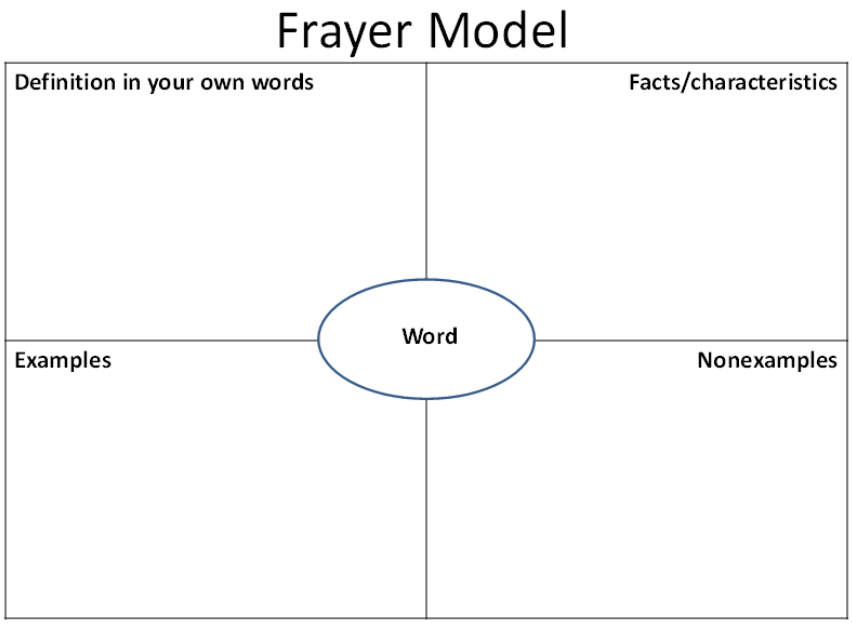
Frayer Model

Mathematics vocabulary is one feature of mathematics text that can be challenging. The Frayer Model is a graphic organizer developed to assist with vocabulary development.

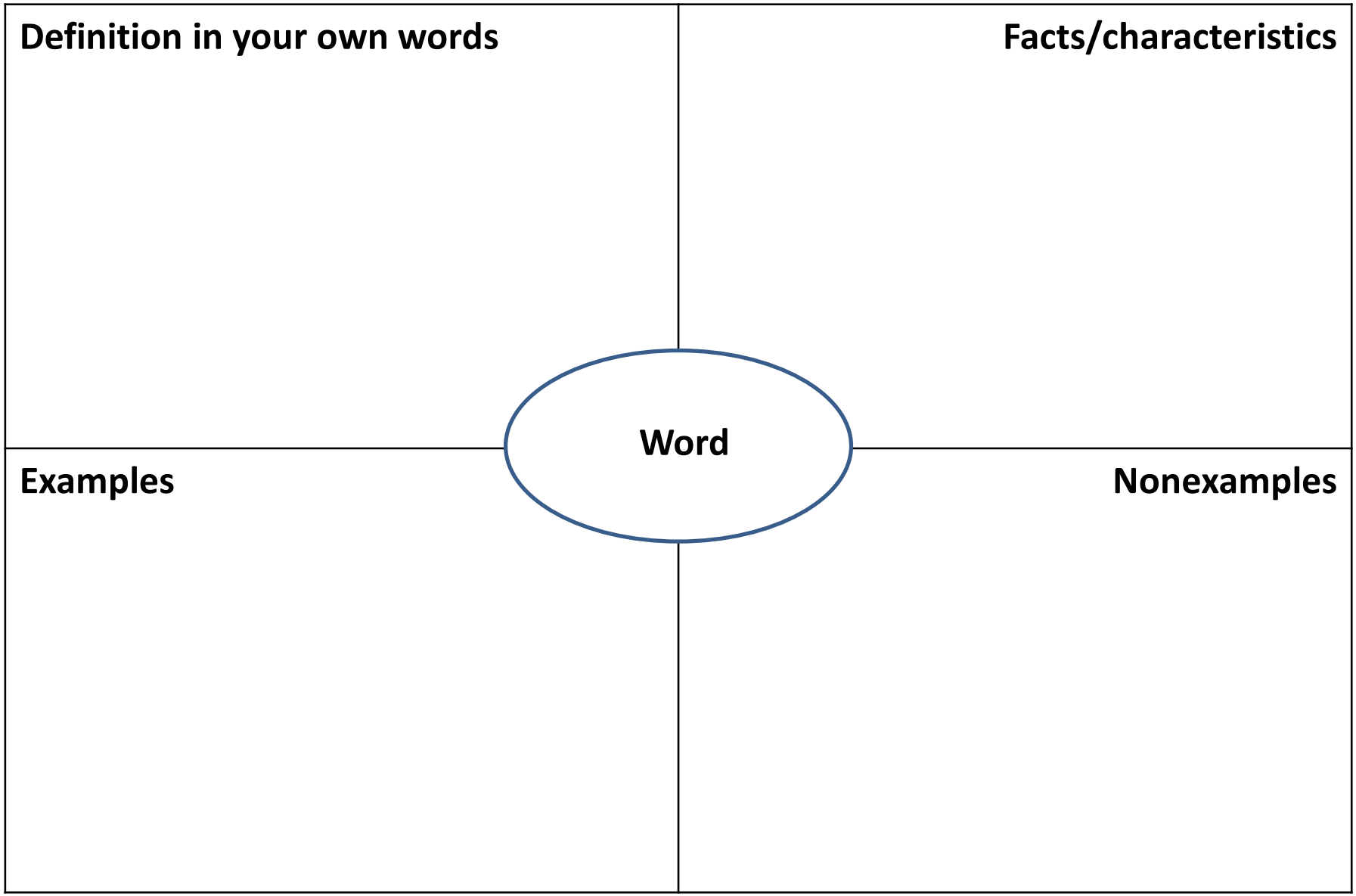


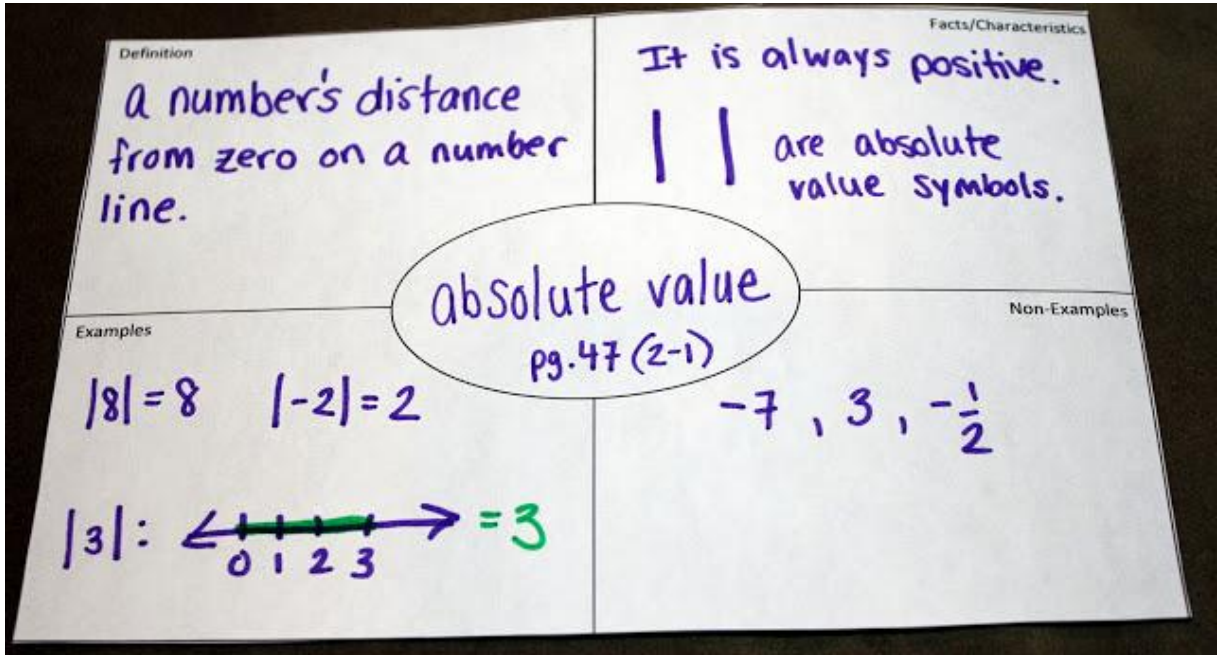
This graphic organizer was designed by Dorothy Frayer and her colleagues at the University of Wisconsin to provide for a thorough understanding of new words. Students are asked to provide a Definition of the word, Facts or Characteristics of the word, Examples, and Nonexamples. This graphic organizer will lead students to a deeper understanding of a word and its relationship to their own lives.

Name _____

PD _____

Frayer Model





Frayer Model

Definition in your own words	**Facts/characteristics**
A quadrilateral is a shape with 4 sides.	•4 sides • may or may not be of equal length • sides may or may not be parallel
Examples	**Nonexamples**
• square • rectangle • trapezoid • rhombus	• circle • triangle • pentagon • dodecahedron

Quadrilateral

Notice that the top two boxes are titled "Definition" and "Facts/Characteristics".
How does thinking about non-examples clarify your understanding about the word?

Definition	**Facts/Characteristics**
An equation is a mathematical statement that shows that two expressions are equal.	- *always has exactly one equal sign* - *the left side is equivalent to the right side* - *some equations have 0, 1, 2 or more solutions* - *some equations contain just numbers* - *some equations are algebraic models for relationships and they have corresponding graphical models and numerical models (e.g., tables)*
Examples	**Non-examples**
3x – 2 = 4x + 7 (linear equation) *ab = ba (an identity)* *F = 1.8C + 32 (a formula)* *5 + 6 = 11 (a number statement)* *P = 2l + 2w (a formula)* *x = 3 (statement of value)*	*2x + 3y (expression)* *3 (number)* *perimeter (word)* *x < y (inequality)* *= 4.2 (has no left side)*

Equation

PROBLEM SOLVING TEMPLATE: This template can be used as another tool that will develop the process of goals and givens. Students will still have multiple reads of the content to complete this template.

Goal: **What is the question?**	**Givens: Important details / information that is provided**

Plan: What strategies will you use? May have multiple checked. Circle the one that was most effective.

- ☐ Draw and Label Diagram/Picture
- ☐ Look for special cases
- ☐ Create and solve a simpler problem
- ☐ Look for patterns
- ☐ Make a table
- ☐ Compare to a similar Problems you have solved
- ☐ Write an equation
- ☐ Work backwards
- ☐ Other _____

Conjecture: (reasonable guess)
Predict your answer and any reasoning that results in your predicted answer

Solution: (make no assumptions, label everything)

- **Start Solving using your plan from above**
- **Move vertically with your work**
- **Show/document ALL work**
  - **Do NOT make any assumptions**
  - **Continue to refer to the word problem**
  - **Be precise and label units while solving & when you have reached a final answer**
  - **Persevere! Keep trying even if it means that you need to change your plan. (trying a new strategy)**
  - **Go as far as you can!**

Solution: (make no assumptions, label everything)

Answer: (Complete sentence answering the goal. Include proper units, notation, etc.)

Write a complete sentence that answers your goal with appropriate units.

Verification: (Explain why your answer makes sense, why it is reasonable, did you answer the goal, is there another strategy that proves your answer is correct?)

How do you know your answer is correct?
Is your answer reasonable?
Did your answer the goal?
Can you convince someone using another method?

Goal/Givens 1 pt	Conjecture 1 pt	Plan 1 pt	Solution 2 pts	Verification 2 pts	Answer 3 pts

Name _____
PD _____

PROBLEM SOLVING TOOL

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