Grade Level	Content Area	Course Title *(9-12 Samples Only)*	Unit Title
1st Grade	**Mathematics**	**N/A**	**Word Problems—1st Level**
Length of Unit	**Time of Year Taught**	**Expected Prior Knowledge**	
3-4 weeks for presentations/lessons **Remainder of year for completing assigned word problem cards**	**2nd Semester—January onward**	✓ Has completed 80% of the facts memorization sequences with the Addition Memorization Board materials ✓ Has begun the facts memorization sequences w/AMB materials ✓ Has a good understanding of the concepts and processes of addition/subtraction ✓ Basic vocabulary of addition/subtraction—addend, sum, minuend, subtrahend, difference, altogether, take away, etc. ✓ Beginning reading level (simple word problems) ✓ Knowledge of symbols and words for quantities to 20	

Unit Description

David and Phyllis Whitin talk about the value of writing in the mathematics curriculum in chapter one of *Math Is Language Too: Talking and Writing in the Mathematics Classroom*. They state that mathematics and language are both "ways for learners to make sense of their world" and that ***"writing and talking are ways that learners can make their mathematical thinking visible."*** One of the most concrete examples of mathematics as language is in the reading and solving of word problems.

Word problems depend on reading comprehension skills for the development of successful problem-solving strategies. Having students collaborate on word problems gives them the opportunity to learn by talking, collaborating, and sharing ideas as they compare pictures, words, and numeric symbols for consistency. The Principles and Standards for School Mathematics, by The National Council of Teachers of Mathematics, includes communication as a mathematics tool for all levels of learners and suggests collaboration as especially beneficial for young learners.

Story and word problems are an essential part of the Operations & Algebraic Thinking domain of the Common Core Standards. In order for students to gain mastery in solving all types of word problem structures it is imperative they have a strong sense of number, quantity, and operational processes. In addition to the mathematical aspects and objectives, students must be able to comprehend the text of the story problem. Once students have completed most of the memorization work using various concrete materials to represent and construct basic equations they are ready to move on to working with larger quantities. The first lesson provided in this sample presents a review (using the Addition Strip Board) of equations with missing variables—solving for ‘x’, or a question mark (?). While reviewing students are encouraged to create an *oral word problem* to represent the equation. For the remainder of the year students receive many and varied lessons and extensions involving word problems. Throughout this work, students are exposed to specific word problem structures (as specified in the AZ Common Core Standards). These word problems are presented in group and individual instruction, and are available on the shelf as “follow up work”. The story problem cards are examples of each common word problem structure, and may be randomly chosen to assess student’s mastery of the required standard for this lesson sample.

This particular sample of lessons focuses primarily on *reading comprehension skills* as they apply to mathematics story problems, as well as to written and verbal mathematics communication skills. It is important for students to learn how to analyze, represent, and solve equations in all four operations, but specifically in addition & subtraction. Through repeated exposure to various story structures within multiple learning modalities, students learn effective strategies that are necessary for solving these type of equations. This sample presents just a glimpse of the lessons and instruction the student will receive over the year's span. In order to ensure our instruction aligns with the required standard we have developed a rubric template for assessing the most common word problem structures. Initially, many of the lessons are given to the small group. As groups students read story problems and answer a series of questions designed to bring out the essential points of the problem. Students then draw a picture on chart paper showing the details of the story problem. They write both an equation and a sentence to represent the problem. Finally, students repeat the process with new problems, working in small groups to create posters using images, text, and mathematical equations to represent a story problem. After having the opportunity to collaborate and learn from the group, students are equipped with the "writing and talking" strategies they need to practice and master solving word problems independently.	
Standards:	**Domain:** Operations and Algebraic Thinking **Cluster:** Represent and solve problems involving addition and subtraction. ***Standard #1:*** *Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.*
Summative Assessment	When given a story problem w/missing variables in addition and subtraction, the student is able to represent/demonstrate process/solution of equation by using an appropriate concrete material, objects, and/or drawing, illustration. Each of the 15 types of common word problem structures will be assessed for progress & mastery on the following rubric components: • Represents equation correctly with material and/or drawing • Uses '?' symbol to represent missing variable • Uses correct calculation symbol ('+' or '-') • Uses '=' sign correctly • Uses logical steps to solve for the missing variable • Is able to articulate the process used to solve for the missing variable • Uses correct vocabulary when referring to the parts of the equation Below is a chart of common word problem structures to be taught and assessed for mastery. The chart also includes sample word problems to illustrate each structure.

STRUCTURE A: "Add to"	Sample Word Problem Cards
1. Result Unknown 12 + 3 = _?_	Twelve friends sat on the lawn. Three more friends joined them. How many friends are on the lawn now?
2. Change Unknown 12 + _?_ = 15	Twelve friends were sitting on the lawn. Some more friends joined them. Then there were 15 friends. How many friends joined the first twelve?
3. Start Unknown _?_ + 3 = 15	Some friends were sitting on the lawn. Three more friends joined them. Then there were fifteen friends. How many friends were on the lawn before?
STRUCTURE B: "Take from"	
1. Result Unknown 15 – 3 = _?_	I have fifteen pennies in my pocket. I spent three pennies. How many pennies do I have left?
2. Change Unknown 15 - _?_ = 12	I have 15 pennies. I spent a few. I have twelve pennies left. How many pennies did I spend?
3. Start Unknown _?_ - 3 = 15	I had some pennies in my pocket. I spent three. Now I have fifteen pennies in my pocket. How many pennies did I have to begin with?
STRUCTURE C: Put together/Take apart	
1. Total Unknown 12 + 3 = _?_	Twelve brown eggs and three white eggs are in the basket. How many eggs are there in all?
2. Addend Unknown 3 + _?_ = 15	I have three eggs in my basket. After I am finished collecting eggs I have fifteen eggs altogether. How many eggs did I collect?
3. Both Addends Unknown **Varies: 15 = 0 + 15; 15 = 1 + 14; 15 + 2 + 13; etc.**	I have fifteen eggs. How many eggs can I put in my red basket and how many in my yellow basket?
STRUCTURE D: Compare	
1. Difference Unknown—"How many more?" 3 + _?_ = 15	Jane has read three poems. Stuart has read fifteen poems. How many more poems has Stuart read than Jane?
2. Difference Unknown—"How many fewer?" 15 – 3 = _?_	Jane has read three poems. Stuart has read fifteen poems. How many fewer poems has Jane read than Stuart?
3. Bigger Unknown—with "more" 2 +13 = _?_	Jane has read two more poems than Stuart. Stuart has read thirteen poems. How many poems has Jane read?
4. Bigger Unknown—with "fewer" 13 + 2 = _?_	Stuart has read 13 poems. He has read two fewer poems than Jane. How many poems has Jane read?
5. Smaller Unknown—with "more" 15 – 3 = _?_	Jane has read 3 more poems than Stuart. Jane has read fifteen poems. How many poems did Stuart read?
6. Smaller Unknown—with "fewer" _?_ + 3 = 15	Stuart has read 3 less poems than Jane. Jane has read fifteen poems. How many poems has Stuart read?

Formative Assessments:

- ✓ Teacher observation of whole group participation (may include 'whole class' participation)
- ✓ Teacher observation of small group & individual participation.
- ✓ Student written & verbal explanations of their strategies in lessons and math journal/notebook
- ✓ Quality of student group & individual work.
- ✓ Quality of individual student follow-up work, including clarity of ideas and details in written work.

Scoring for Summative Assessment

Below is a sample Student Progress for Addition/Subtraction Word Problem Structures. Once students are ready, they will randomly select one, or more story problem cards (ensure that if more than one card is pulled, it is a different word problem structure) to represent using materials, objects, or drawings and text. The teacher indicates a score for each of the seven identified components to be scored. The criteria for mastery is 12/14 points (80%) per word problem structure, or 168/210

points (80%) across all 15 structures.

Student Progress for Addition/Subtraction Word Problem Structures

STUDENT:

SCORING KEY: 1 = Needs more practice 2 = Meets objective 3 = Exceeds objective **Criteria for mastery** = 12/14 points (80%) minimum for mastery per word problem structure, or 168/210 points (80%) for total 15 structures.	Represents equation correctly with material and/or	Uses '?' symbol to represent missing variable	Uses correct calculation symbol ('+' or '-')	Uses '=' sign correctly	Uses logical steps to solve for the missing variable	Is able to articulate the process used to solve for the missing	Uses correct vocabulary when referring to the parts of the equation	TOTAL POINTS	OBSERVATION NOTES
STRUCTURE A: "Add to"									
1. Result Unknown **12 + 3 = _?_**									
2. Change Unknown **12 + _?_ = 15**									
3. Start Unknown **_?_ + 3 = 15**									
STRUCTURE B: "Take from"									
1. Result Unknown **15 – 3 = _?_**									
2. Change Unknown **15 - _?_ = 12**									
3. Start Unknown **_?_ - 3 = 15**									
STRUCTURE C: Put together/Take apart									
1. Total Unknown **12 + 3 = _?_**									
2. Addend Unknown **3 + _?_ = 15**									
3. Both Addends Unknown **Varies: 15 = 0 + 15; 15 = 1 + 14; 15 + 2 + 13; etc.**									
STRUCTURE D: Compare									
1. Difference Unknown—"How many more?" **12 + _?_ = 15**									
2. Difference Unknown—"How many fewer?" **15 – 3 = _?_**									
3. Bigger Unknown—with "more" **12 + 3 = _?_**									
4. Bigger Unknown—with "fewer" **13 + 2 = _?_**									
5. Smaller Unknown—with "more" **15 – 3 = _?_**									
6. Smaller Unknown—with "fewer" **_?_ + 3 = 15**									

Materials/Resources Needed	**Montessori Materials:** Addition Working Chart 1 Bead Bar box Operations symbols **Other Materials:** Small paper squares with '?' indicating unknown Prepared "special combinations" for addition (teacher made—to	Dry erase board & markers Student math notebooks Chart paper Colored markers, pencils Glue sticks White construction paper (12 x 18) 4-6 enlarged word problems for Lessons 2 & 3 to be

	go on shelf)	pasted on chart

	Lesson 1—Word Problems 1st Level	Lesson 2 & 3—Beginning Strategies	
Instruction and Timeline	**Aims:** ✓ To increase the interest of students in the memorization of addition ✓ ***To provide practice using materials to represent and solve types of addition & subtraction equations with unknown quantities in all positions*** ✓ Indirect preparation for subtraction For this presentation, the teacher must prepare special combination cards based on the following samples: ✓ Calculation of a second addend 6 + ___ = 8 ✓ Calculation of a first addend ___ + 2 = 8 ✓ Inverse of (1) & (2) above ___ = 6 + 2 ✓ Inverse calculation of the second addend 8 = 6 + ___ ✓ Inverse calculation of the first addend 8 = ___ + 2 ✓ Calculation of both addends 8 = ___ + ___ These "special combinations" can be mixed together in one box, or isolated into 6 separate boxes. Addition Chart 1 is used as a 'control of error', only if required. Using operations symbols and bead bars, demonstrate the layout (visual	**Aims:** Students will ✓ participate in a shared word problem-solving activity. ✓ collaborate in small groups to develop a word problem-solving strategy. ✓ ***use drawings, words, and equations to model solutions to word problems.*** ✓ effectively and clearly explain their word problem-solving strategies to other students. ✓ write about and reflect on their word problem-solving strategies. Post chart paper on the wall and gather students together near it. Inform them that they will work together to solve a math story, and that later they'll work in groups to solve their own. Start with a completely blank chart paper so that students can see the entire process. On the top left corner glue one story problem. Ask for a volunteer to read the problem aloud, or read it to the group. Ask for students to identify the most important information in the story. To do this, ask the following questions: ✓ What is this story problem about? ✓ How many [subjects/objects] are there to begin with? ✓ What is happening to these	Gather students together to review the *Giant Story Problem chart* from Session One. Have students review each part of the problem-solving process. Ask them to review the step-by-step process and list the directions on the board: ✓ glue problem on paper ✓ read story problem ✓ underline important words ✓ draw ✓ write equation ✓ write sentence Have students get into groups. Each group will need one sheet of white construction paper (12x18), crayons, writing materials, and one story problem. (Every group should have a different problem.) If desired, assign each group a leader whose job it would be to make sure everyone in the group is participating. While students work to solve their story problems, check in with individual members of the group asking questions and making sure everyone is participating in the process. If students are having difficulty, try to ask leading questions rather than give them specific help with a strategy, or suggest they ask a group member. If it appears that students are using an inappropriate strategy, help them refer back to the language of the story problem. As they work, let them know

	representation) of each of these special cases. Allow students to practice while in the group and encourage sharing of verbal stories to illustrate/represent the equation.	[subjects/objects]? As students identify the information, highlight or underline the information that will be needed to solve the problem. When important words and numbers have been highlighted, work through the story problem item by item to create a drawing that models the story. Have students volunteer to do the drawings on the chart paper. All pertinent information should be illustrated. For example, in a story problem about three people who have four cookies each, the drawing would show three people, each with four cookies. Any details will be up to the students doing the drawing. When the drawing is finished, review with students the language of the story problem and compare it to the drawing, checking for accuracy: "Does this picture show what it says in the story?" Ask for an equation or number sentence that will show what the drawing says and which will solve the problem. If a student suggests an incorrect equation, write it on the board (not on the chart paper) and ask students to tell why it will or will not work. When a student states a correct equation, compare it with the drawing, then have him or her write it under the drawing with a marker after other students agree that the equation will work. Ask students to find the actual question in the story problem that needs to be answered: "What does this story want to know?" Read it aloud. Ask for a complete	that they may share their work with the group if desired. When all groups are finished, invite students to share their posters with everyone, explaining their drawing by referring to their story problem, and telling why their mathematical solution will work to solve the problem. To conclude the activity, have students respond on paper or in Math Journals to each of the following questions: How did drawing a picture help you solve the story problem? What was the most interesting thing about this lesson? Display all the Giant Story Problems on the wall.

		sentence that answers the question. When a sentence has been agreed upon that includes specific information (e.g., the subject's name, the numbers involved, the items' names, etc.), have a student write the sentence under the equation, using conventional capitalization and punctuation, and writing all numbers as words (i.e., instead of writing "20" a student would write "twenty") to facilitate correct spelling of number words. Review all parts of the chart, and leave it posted for Session Two, as well as serve as a reminder for on-going independent practice.	

	Lesson 1	**Lesson 2 & 3**
Student Activities and Timeline	Independent practice with all 15 word problem structures using concrete materials & objects (“special combinations”). Record work in math notebook & notify teacher when ready to “check for mastery” in chosen word problem card. Practice creating oral word problems with a friend and record them in math notebook.	✓ Have students meet in groups to write their own story problems, then have the groups exchange problems to solve. ✓ Have students practice spelling number words at *FunBrain website*. (On line student math site) ✓ Prepare additional "giant" story problems to keep on the math shelf for students to work on independently or with a partner. ✓ Photocopy "regular-sized" story problems from workbooks, cut them up individually, and put them in a basket for students to choose from. These can be used by individual students using the same procedure as "giant" story problems, but on regular-sized paper.