

SOAR: Intervention Survey

GRADES
1 to 5

Operations and Algebraic Thinking:
Addition and Subtraction

Operations and Algebraic Thinking: Addition and Subtraction Survey Grades 1 to 5

The Operations and Algebraic Thinking Survey for addition and subtraction is an informal survey designed for students who show and indication, based on the universal screener, of not performing at a satisfactory level. The survey focuses on the common types of addition and subtraction word problems and allows the user to view student performance through the lens of sense-making, use of representations, use of strategies, and mathematical explanations.

Survey Categories

- I. Approaches to Solving Single-Digit Addition and Subtraction Situational Word Problems
- II. Approaches to Solving Two-Digit Addition and Subtraction Situational Word Problems
- III. Approaches to Solving Three-Digit Addition and Subtraction Situational Word Problems

Four Mathematical Practices

Four mathematical practices can be used to determine an understanding of situational word problems. These include

- Making Sense of the Situational Word Problem;
- Using Representations to Show and Solve a Situational Word Problem;
- Using Problem-Solving Strategies; and
- Meaning of the Numbers in Context.

Rationale for the Design of the Survey

Research over the last several decades has revealed that good math problem-solvers develop a representation of the problem they are attempting to solve (Riley, Greeno, & Heller, 1983; Nathan, Kintsch, & Young, 1992; Halford, 1993; English, 1997; Pape, 2004; and others). Students construct a mental model of the information and the relationships among the elements of the problem. They use this information to select a solution strategy and then apply the strategy to find the answer. The better students are at recognizing the problem situation and representing it, the better their ability to solve more complex math problems (Stigler, Fuson, Ham, & Kim, 1986; Marshall, 1995).

Note: This survey has not been designed to measure a student's ability to compute, though computation is required by the survey. It is suggested that either the universal screener or a separate computation assessment be used to measure computational skills.

Materials Needed

To administer this survey, in addition to this document, you will need

- Addition and Subtraction Checklist to record your observations about student performance and
- Addition and Subtraction Student Prompt Book that contains the word problems in print and workspace.

The following manipulatives for each category of questions will also be needed:

- Category I: a hundreds chart, a number line, manipulatives such as blocks, chips, popsicle sticks, connecting cubes
- Category II: tens and ones blocks, 100 popsicle sticks bundled into tens and ones, a set of 100 counters, connecting cubes
- Category III: hundreds, tens, and ones blocks; connecting cubes

You will follow the instructions given for each word problem in this survey, noting the appropriate indicators on the checklist. Once the student has attempted each word problem, you will note the appropriate general observations on the checklist.

Administration of the Survey

The survey can be completed as a one-on-one interview (approximately 20 minutes for each section). The survey can be given to a small group of students as well. If the survey is used with a small group of students, it will be important to vary the students who are called on first as to minimize the influence other students' responses have on the results. This will help ensure you get an actual measure of each student's ability to solve the word problems.

- Students in Grade 1 whose performance on the universal screener suggests a need for additional support will need to complete Category I.
- Students in Grade 2 whose performance on the universal screener suggests a need for additional support may need to complete Categories I and II. Some Grade 2 students may need to complete only Category II depending on their level of entry.
- Students in Grade 3 to 5 whose performance on the universal screener suggests a need for additional support may need to complete Categories I, II, and III. Some students may need to complete only Category II and/or Category III depending on their level of entry.

Before starting the survey, fill out the information on the top of the checklist, including the date on which you are giving the survey. As previously noted, a copy of each of the word problems is provided in the Student Prompt Book that should be used during the survey. The teacher is encouraged to read the word problems to the students since this is not a test of a student's reading ability.

Note: We recommend the use of the Student Prompt Book so that students are able to see and hear the word problem, as well as refer back to the word problem, as necessary. Students who are only hearing the word problems must rely on working memory to remember the word problem rather than making sense of the mathematics represented by the word problem.

Start the survey by saying: *"I like to learn about how my students are thinking about and solving problems. This is why we are meeting. I am going to give you a word problem. You can use any materials on the table to solve the word problem. Notice we have counters, square tiles, _____. I want you to talk out loud about how you are solving the word problem so I know how you are thinking about the situation. If you need a word problem repeated, please ask me to repeat the problem."* If needed, repeat this statement to them throughout the survey.

This survey is a tool designed to find out where students are in their learning; therefore, the interview questions provided on the next several pages are limited and reflect only those questions that probe for student understanding.

Category I

Situational Word Problems
1. Mary has 6 cookies. She gets 6 more cookies. How many cookies does she have altogether? (Add To, Result Unknown, Solving for the Whole)
2. Joe has 5 red pencils and 8 green pencils in his case. How many pencils does he have in the case? (Put Together, Total Unknown, Solving for the Whole)
3. Sam has 12 pieces of candy. He eats 5 pieces. How many pieces of candy does he have left? (Take From, Result Unknown, Solving for a Part)
4. Jen has 16 books. 7 of the books are mysteries and the rest are about animals. How many animal books does Jen have? (Take Apart, Addend Unknown, Solving for a Part)
5. Jean has 8 cookies. She gets some more cookies. Now she has 14 cookies. How many more cookies did she get? (Add To, Change Unknown, Solving for a Part)
6. Jake has some animal books. He has 7 car books. Altogether he has 12 books. How many of the books are animal books? (Put Together, Addend Unknown, Solving for a Part)
7. Tabitha has 11 star stickers. She puts some of the star stickers on her paper. She has 5 star stickers left. How many did she put on her paper? (Take From, Change Unknown, Solving for a Part)
8. Some oranges are on the table. Tom ate 8 of the oranges. How many oranges were on the table if Tom has 9 oranges now? (Take From, Start Unknown, Solving for the Whole) *Not an expectation until Grade 2
9. Mary has 8 rings and John has 12 rings. How many more rings does John have than Mary? (Compare/More, Difference Unknown, Solving for a Part) *Not an expectation until Grade 2
10. Matt has 7 balls and Jim has 13 balls. How many fewer balls does Matt have than Jim? (Compare/Fewer, Difference Unknown, Solving for a Part) *Not an expectation until Grade 2

	Interview Questions
Makes Sense	<ul style="list-style-type: none"> • <i>What do you know about the word problem?</i> • <i>What do you have to figure out in the word problem?</i> • <i>Tell me how you thought about the problem.</i> • <i>What is the solution to the word problem?</i>
Creates Representations	<ul style="list-style-type: none"> • <i>Show me how you figured out the number of _____.</i> • <i>Show how you can use the _____ to represent the word problem.</i> • <i>Draw a picture to tell about the _____.</i> • <i>Write an equation to tell about the _____.</i>
Uses Reliable Strategies	<ul style="list-style-type: none"> • <i>How did you figure out _____?</i> • <i>Tell me what you did to figure out _____.</i> • <i>Show me how you can figure out _____.</i>
Provides Explanation	<ul style="list-style-type: none"> • <i>What do the numbers tell us about in the situation?</i> • <i>Tell me what the numbers mean in the equation.</i>

Category II

Situational Word Problems	
1.	Mary has 26 cookies. She gets 36 more cookies. How many cookies does she have altogether? (Add To, Result Unknown, Solving for the Whole)
2.	Joe has 35 red pencils and 48 green pencils in his case. How many pencils does he have in the case? (Put Together, Total Unknown, Solving for the Whole)
3.	Sam has 62 pieces of candy. He eats 25 pieces. How many pieces of candy does he have left? (Take From, Result Unknown, Solving for a Part)
4.	Tabitha has 81 star stickers. She puts some of her star stickers on her paper. She has 35 star stickers left. How many star stickers did she use? (Take From, Change Unknown, Solving for a Part)
5.	There were some oranges on the table. Tom ate 28 of the oranges. There are 19 oranges on the table now. How many oranges were on the table? (Take From, Start Unknown, Solving for the Whole)
6.	Mary has 48 rings and John has 92 rings. How many more rings does John have than Mary? (Compare/More, Difference Unknown, Solving for a Part)

Interview Questions	
Makes Sense	<ul style="list-style-type: none"> • <i>What do you know about the word problem?</i> • <i>What do you have to figure out in the word problem?</i> • <i>Tell me how you thought about the problem.</i> • <i>What is the solution to the word problem?</i>
Creates Representations	<ul style="list-style-type: none"> • <i>Show me how you figured out the number of _____.</i> • <i>Show how you can use the _____ to represent the word problem.</i> • <i>Draw a picture to tell about the _____.</i> • <i>Write an equation to tell about the _____.</i>
Uses Reliable Strategies	<ul style="list-style-type: none"> • <i>How did you figure out _____?</i> • <i>Tell me what you did to figure out _____.</i> • <i>Show me how you can figure out _____.</i>
Provides Explanation	<ul style="list-style-type: none"> • <i>What do the numbers tell us about in the situation?</i> • <i>Tell me what the numbers mean in the equation.</i>

Category III

Situational Word Problems	
1.	Sue has 226 pencils. She gets 336 more pencils. How many pencils does she have altogether? (Add To, Result Unknown, Solving for the Whole)
2.	Joseph has 345 red pencils and 248 green pencils in his case. How many pencils does he have in the case? (Put Together, Total Unknown, Solving for the Whole)
3.	Sam has 462 pieces of candy. He eats 325 pieces of candy. How many pieces of candy does he have left? (Take From, Result Unknown, Solving for a Part)
4.	Tabitha has 681 star stickers. She puts some of her star stickers on her paper. She has 435 star stickers left. How many star stickers did she use? (Take From, Change Unknown, Solving for a Part)
5.	There were some oranges on the table. Tom ate 128 of the oranges. There are 319 oranges on the table now. How many oranges were on the table? (Take From, Start Unknown, Solving for the Whole)
6.	Mary has 448 rings and John has 592 rings. How many more rings does John have than Mary? (Compare/More, Difference Unknown, Solving for a Part)

Interview Questions	
Makes Sense	<ul style="list-style-type: none"> • <i>What do you know about the word problem?</i> • <i>What do you have to figure out in the word problem?</i> • <i>Tell me how you thought about the problem.</i> • <i>What is the solution to the word problem?</i>
Creates Representations	<ul style="list-style-type: none"> • <i>Show me how you figured out the number of _____.</i> • <i>Show how you can use the _____ to represent the word problem.</i> • <i>Draw a picture to tell about the _____.</i> • <i>Write an equation to tell about the _____.</i> •
Uses Reliable Strategies	<ul style="list-style-type: none"> • <i>How did you figure out _____?</i> • <i>Tell me what you did to figure out _____.</i> • <i>Show me how you can figure out _____.</i>
Provides Explanation	<ul style="list-style-type: none"> • <i>What do the numbers tell us about in the situation?</i> • <i>Tell me what the numbers mean in the equation.</i>