

# Appendix

## Mathematics Problem Solving Student Directions

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*Please show your answer and all of your work (first efforts and those that worked) in the spaces provided, so everything you do is clear to the readers.*

**You may use manipulatives or a calculator to work on your problem.**

To receive the highest score in each of the five areas, you will want to be certain your work **SHOWS** each of these parts of a successful solution.

**1. CONCEPTUAL UNDERSTANDING – the “what”**

- q I showed that I used the important information, changing it into mathematical ideas.
- q The mathematics I used fits what was requested in the problem.

**2. PROCESSES & STRATEGIES – the “how”**

- q I used mathematical problem solving skills/strategies that fit the problem.
- q I showed all of the diagrams, pictures, models, number and/or symbols I used to solve the problem.

**3. VERIFICATION – the “defense”**

- q My review of the concepts, processes and calculations I used to get to my solution is **clearly identified.**
- q If appropriate, I worked the entire problem a second way to defend my first solution.

**4. COMMUNICATION – the “connecting path”**

- q The path leading to my complete solution is shown with no gaps for the reader to fill in.
- q My work fits all of the parts (the concepts, strategies, and verification) together by using pictures, charts, diagrams and/or words.

**5. ACCURACY – “correctness”**

- q My final answer is complete, justifiable and **clearly identified.**
- q My answer matches what the problem was asking.

## ***Suggestions for Teaching Problem Solving***

***OR***

### ***How to help children become mathematical thinkers, successful problem-solvers and clear mathematical communicators***

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- ↳ Model and practice problem solving as a whole group.
- ↳ Provide students with tools such as number charts, grid paper, calculators and manipulatives.
- ↳ Generate lists of possible strategies for solving problems.
- ↳ Share a variety of strategies, solutions and examples of verification in whole and small group discussions, on group posters or in problem solving journals.
- ↳ Post an enlarged scoring guide in the classroom. Have students generate vocabulary and language they understand.
- ↳ Model scoring student work samples together on the overhead.
- ↳ Have students generate, post and use problem solving sentence starters.
- ↳ Have students complete a scoring guide puzzle.
- ↳ Have students write in their own words what the four dimensions of the scoring guide mean.
- ↳ Have students score papers just like the teachers do in a workshop.
- ↳ Improve a work sample (on overhead together or in small groups).
- ↳ In small groups, solve a problem, record work on a poster and do a “field trip” to make comments and/or give scores.
- ↳ \*Have a “mathematicians chair” where a student may sit to share original problems that they have authored or solutions they have found to a problem.
- ↳ Have students respond to questions that elicit thinking in the math journal.
- ↳ Present an already solved problem with a significant error. Give the problem and how another student solved it. Have students explain whether the student’s reasoning was correct or incorrect.
- ↳ \*Present a problem and the answer arrived at by an imaginary person. Write a letter to this person, explaining agreement or disagreement with the answer:

Which number does not belong in this set?

10    13    6    12

Kristi thinks the answer is 6.

- ↳ \*Present a problem, but have students write a different question for the problem, solve the new problem and explain why it is easier or harder than the original problem.
- ↳ Present a “situation” and have the students write the questions and solve them.
- ↳ Present a problem with a partial solution. Have the students complete the solution.

## ***Kindergarten and First Grade***

### ***More suggestions for teaching problem solving***

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Essential to becoming a problem solver and critical thinker is the use of concrete materials. Young learners need to have concrete experiences in which to build conceptual understanding. Manipulatives should dominate the problem solving curriculum. Teachers need to model problems, strategies and solutions using manipulatives. Students need time to explore problems, and strategies using manipulatives.

Whole group discussions should permeate problem solving lessons at kindergarten and first grade. Teachers must model and emphasize the correct use of problem solving related language. Students must be provided with ample opportunities to share their thinking and observations in group discussions.

Kindergarten and first grade teachers do not need to formally score students' work using the scoring guide; however, teachers must be familiar with the components of the problem solving scoring guide to teach the strategies embedded in the scoring guide. The problem solving experiences students have in kindergarten and first grade serve as the foundation for student success in succeeding grades.

Kindergarten and first grade students do need to have 2 mathematics problem solving work samples in their RSD Collection of Evidence. Work samples should be individual work. Students' responses to tasks may be dictated to a scribe when appropriate.

# ***Suggested Questions and Prompts to Help Children Build Mathematics Power***

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## ***Teaching Children Mathematics***

### **To help children make sense of mathematics:**

- ↳ Did anyone get the same answer in a different way?
- ↳ Did anyone get a different answer? How did you get your answer?
- ↳ What do you think helped you decide how to get your answer?
- ↳ Tell me (or the class) what you were thinking?

### **To foster predicting, inventing and problem solving:**

- ↳ What would happen if...?
- ↳ Is there a pattern? What is it?
- ↳ What decisions can you make from this pattern?
- ↳ What is the same or difference about your two ways of doing this? (This question could refer to two ways by the same student or by two different students.)
- ↳ What do you think will happen next? How do you know?
- ↳ Can you change something to make it come out differently? What? Why do you think that works?
- ↳ Will it be the same if we use different numbers? Why or why not?

### **To encourage children to rely more on themselves:**

- ↳ Does it make sense to you? Why or why not?
- ↳ What would seem more reasonable to you? Why?
- ↳ How can you check to see for yourself?
- ↳ What do you think you should do next?
- ↳ How do you think I should find out?
- ↳ What do you want me to do next?
- ↳ Please explain your way to the class.
- ↳ Make a model (using materials or a drawing) to show what it means.
- ↳ Find a classmate and see if you can work it out together.

### **To foster reasoning:**

- ↳ Will what you did always work that way? How do you know?
- ↳ Do you see a pattern in this? How can you make it easier to see?
- ↳ How could it be done a shorter way?
- ↳ What other numbers will work?
- ↳ Are there some numbers for which that will not work? How do you know?
- ↳ Write a new problem that is different in some ways but the same in others.
- ↳ What is the largest number you can think of that will work? The smallest?
- ↳ Why do you want to change your answer?

### **To help children connect and apply mathematics:**

- ↳ How does this relate to...?
- ↳ Have you ever solved a problem like this before?

## ***Problem Solving Strategies***

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***Act out or use objects*** - helps problem solver to develop visual images of data and process.

***Make a picture, diagram or model*** - helps problem solver to understand concept and manipulate data.

***Use or make a table, chart, list or graph*** - helps problem solver to track data and/or spot missing data; often with other strategies.

***Make an organized (systemic) list*** - helps problem solver organize thinking, review and identify steps to be completed.

***Guess and check (eliminate possibilities)*** - helps problem solver to get started when there are many pieces of data or to find one correct answer out of many solutions.

***Use or look for a pattern*** - helps to solve many different kinds of problems, often used with “making a table.”

***Work backwards*** - helps when problem solver must make a series of computations.

***Use logical reasoning*** - helps all problem solving including problems with conditional statements such as “if...then”; often used with “making a chart.”

***Make it simpler*** - helps problem solver with complex problems, large numbers, or large number of items.

***Brainstorm*** - helps problem solver to think of a strategy or look at a problem in

Scorer	CU	PS	V	C	Acc

Name \_\_\_\_\_

Date \_\_\_\_\_

Teacher \_\_\_\_\_

Exceeds    Meets    Does Not Yet Meet    On-Demand    Revised/Redone    Modified

Comments: \_\_\_\_\_

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Strand: \_\_\_\_\_