

Reynolds School District No. 7
2000-2001 Mathematics Problem Solving Bank

The 2000-2001 revised RSD Problem Solving Bank provides teachers at each grade level with a packet of common mathematics tasks. These tasks are intended to:

1. Help students learn mathematical problem solving skills.
2. Prepare students to earn the Oregon CIM.
3. Provide collection of evidence work sample entries.

The tasks also serve as a support to teachers as they provide all students with consistent problems and reliable scoring as an integral aspect of learning mathematics.

At each grade level the revised Problem Solving Bank includes student problems and an appendix: 2000-2001 scoring guides, problem solving hints and black line masters. The tasks in the Bank address each of the Oregon Content Standards Strands:

Grades K-5	Grades 6-10
<ul style="list-style-type: none">• Computation and Estimation• Measurement• Geometry• Algebraic Relationships• Probability and Statistics	<ul style="list-style-type: none">• Probability and Statistics• Geometry• Algebraic Relationships• Measurement (middle school)

Reynolds is requiring that students have two (2) distinct mathematics work samples in their 2000-2001 Collection of Evidence. These work samples must represent a student's effort in different strands.

The Oregon Mathematics Problem Solving Assessment at grades 5, 8 and 10 allows students to choose one of three tasks to solve. The tasks in the Bank include only one problem per page. Teachers will need to prepare students to be able to analyze several tasks and to make a choice as to which task will best ensure success on the formal State assessment.

Teachers are encouraged to use as many of these tasks as possible, but are equally encouraged to gather, adapt and use appropriate problems from other resources. A work sample may be collected under assessment conditions or as a regular classroom assignment, and may be revised by the student.

Please keep your school's math representative informed of students' success or lack thereof with these tasks so that appropriate additions, deletions or modifications can be made to the RSD Problem Solving Bank.

Kindergarten Problem Solving Tasks

TABLE OF CONTENTS

Algebraic Relations

KA01	Gingerbread Men.....	Patterning
KA02	Patterns	Patterning

Calculations and Estimations

KC01	Counting Objects.....	Counting/Additions
KC02	How Many Fingers?	Calculations

Geometry

KG01	Make a Picture.....	Creating With Shapes
KG02	Shapes Walk	Looking for Shapes
KG03	Shape Sorting	Sorting for Shapes

Measurement

KM01	How Long Is Your Shoe?	Length
KM02	Heavy or Light.....	Weights

Probability and Statistics

KP01	Variety of real and picture graphs
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APPENDIX

1	Mathematics Problem Solving Student Directions
2-5	Mathematics Problem Solving Official Scoring Guides (2000)
6	RSD Pre-Benchmark Student Self-Evaluation
7	Suggestions for Teaching Problem Solving Skills
8	K-1: More Suggestions
9-15	Kindergarten Record Keeping Option
16	Questions that Build Mathematical Power
17	Problem Solving Strategies
18	Hints for Successful Problem Solving
19	Grid Paper

Teacher Notes

Gingerbread Man

(Algebraic Relations)

Materials Needed:

- Five (5) large gingerbread men
- Container of Buttons

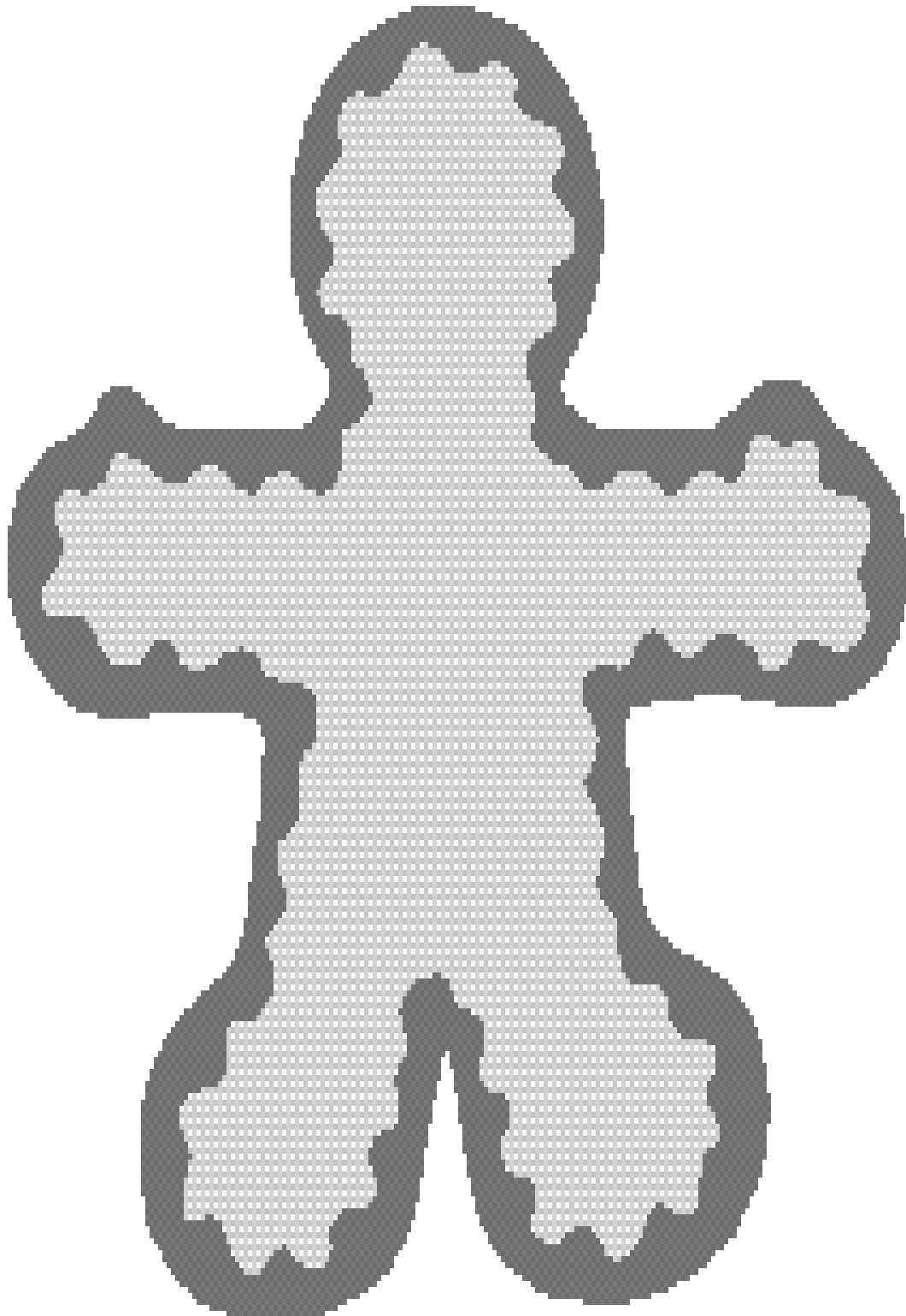
Teacher Directions:

- Lay the 5 gingerbread men across the table in a row.
- Place 1 button on the 1st gingerbread man. Tell the child what you are doing.
- Place 2 buttons on the 2nd gingerbread man. Tell the child what you are doing.
- Ask the child to place buttons on the 3rd gingerbread man and tell you why he/she did it that way.
- Ask the child to put buttons on the 4th and 5th gingerbread men and tell you why he/she did it that way.

Extensions:

- Follow the same procedure with other patterns (2, 4, 6...); red, blue, red. Use balloons, flowers, etc. in place of buttons.

KA01



Teacher Notes

Patterns (Fall/Spring)

(Algebraic Relations)

Materials Needed:

- Pattern blocks (complete set)
- Die cut pattern block shapes (complete set)
- 14” paper strips
- Glue

Teacher Directions:

- Ask students to create a linear pattern on their table using pattern blocks.
- Have students recreate and glue their pattern on a large paper using die cut pattern block shapes.

KA02

Teacher Notes

Counting Objects

(Calculations & Estimations)

Materials Needed:

- Up to 10 counting objects (beans, unifix cubes, bears, etc.)
- Two (2) containers (butter tubs, small bowls, etc.)

Teacher Directions:

- Based on your knowledge of the student, start with an appropriate number of counters.
- Place the object(s) in the bowls (i.e., one (1) in one bowl and two (2) in the other bowl).
- Ask the child how many objects (beans, cubes or bears, etc.) there are all together.
- Redistribute them in bowls using the same number of objects (i.e., first time 2 in each bowl, second time 3 in one bowl and 1 in the other bowl).

Extensions:

- Try again with other numbers.

Note to Teacher:

- Allow student to handle counters.

KC01

Scorer	CU	PS	V	C

Name _____

Date _____

Teacher _____

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

Comments: _____

(Calculations & Estimations)

How Many Fingers?

You have 5 fingers on one hand. How many fingers do you have on 2 hands? Show how you know.

KC02

Teacher Notes

Make A Picture

(Geometry)

Materials Needed:

- Paper Shapes
- Large paper
- Glue

Teacher Directions:

- Tell students to make a picture using circles, squares and triangles.
- When the child's picture is done, ask him/her to name some of the shapes he/she used.

Extensions:

- Include other shapes, such as rectangles or hexagons.

KG01

Scorer	CU	PS	V	C

Name _____

Date _____

Teacher _____

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

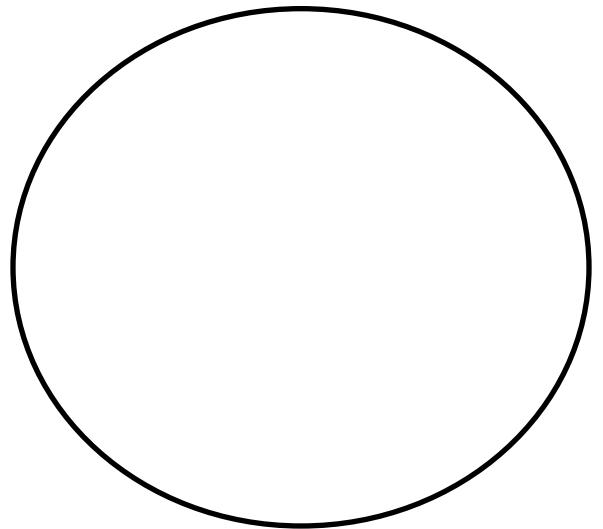
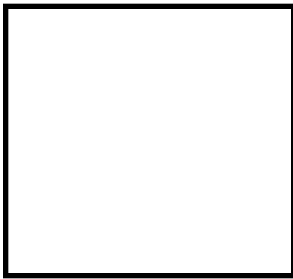
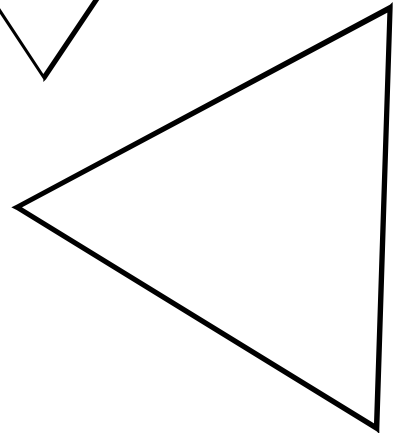
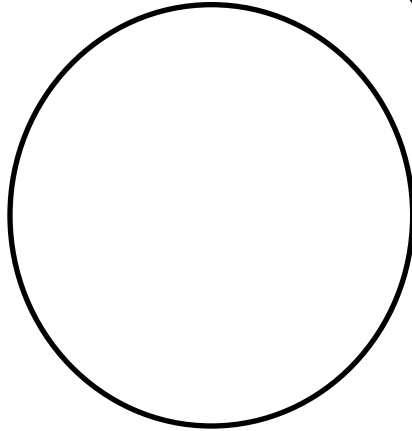
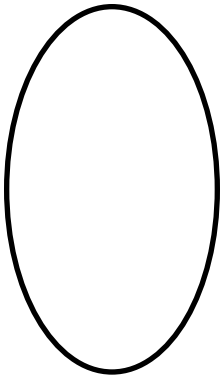
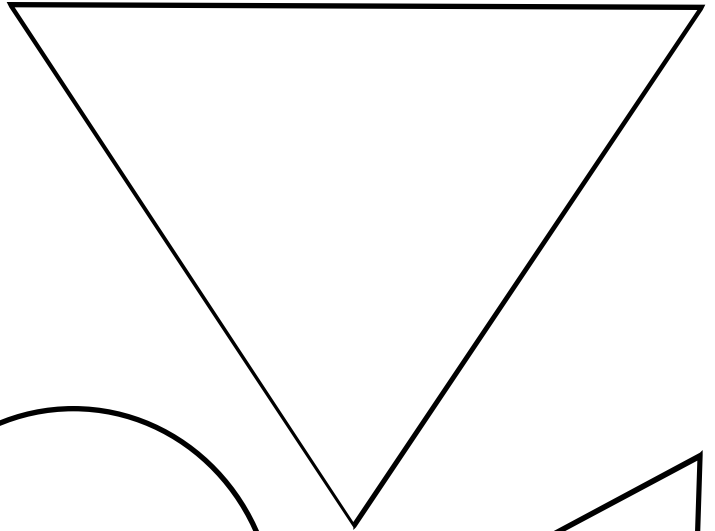
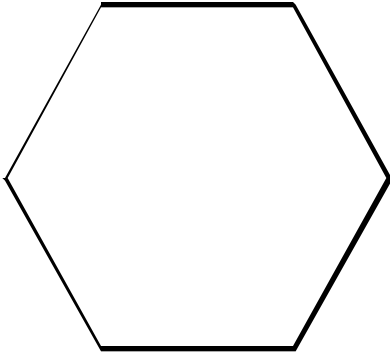
Comments: _____

(Geometry)

Make a Picture

Make a picture using circles, squares and triangles.

KG01



Teacher Notes

Shapes Walk

(Geometry)

Teacher Directions:

- See “Box it or Bag It,” (K) Shapes Walk, pg. 163. Go on a walk around your school searching for a shape that has been predetermined by the teacher. Each time a shape is discovered, stop and discuss it. Back in the classroom, ask children to draw one of the objects they saw containing the identified shape(s).

Notes:

- Before copying this paper, write the name of the shape students will be looking for.

KG02

Scorer	CU	PS	V	C

Name _____

Date _____

Teacher _____

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

Comments: _____

(Geometry)

Shapes Walk

On our walk, we will look for _____ .

Draw something that you found with our shape.

Teacher Notes

Shape Sorting

(Geometry)

Materials Needed:

- Attribute blocks presorted into bags of only 1 thickness and 1 size.
- Check list

Teacher Directions:

1. Give the child a bag of attribute blocks that are all the same size and thickness.
2. Ask the child to sort the blocks. Record how he/she sorted them.
3. Ask the child to sort them another way. Record.
4. Continue until the child has no more sorting ideas. (Most students will do color as one way and shapes as another.)

Notes:

- The small thin group may be hard for some Kindergarten students to handle.

Teacher Notes

(Measurement)

How Long Is Your Shoe?

Materials Needed:

- Unifix Cubes

Teacher Directions:

- Have students take off a shoe.
- Ask students to measure the length of their shoe using unifix cubes.
- Check to see that the students have lined up the beginning of the unifix cube train with the heel or toe of the shoe.
- Ask the students to tell how many unifix cubes long their shoe is.

KM01

Teacher Notes

Heavy or Light

(Measurement)

Materials Needed:

- A collection of objects (tape dispenser, full can of pop, large book, boot, pencil, crayon, small post-it pad, cookie cutter, etc.)
- One (1) large red piece of construction paper marked “Heavy.”
- One (1) large yellow piece of construction paper marked “Light.”

Teacher Directions:

- Place the tape dispenser on the red paper and say, “This is heavy.” Ask the child to pick it up.
- Place the pencil on the yellow paper and say, “This is light.” Ask the child to pick it up.
- Give the child 4-6 other objects and ask him/her to put them in the heavy group or the light group.

Extension:

- Try 3 groups; light, medium, heavy for advanced students.

KM02

Probability and Statistics

Graphing

Kindergarten children need many opportunities to graph using real objects. Begin with two column graphs and gradually move to three and four column graphs. Move to picture and bar graphs while periodically returning to real graphs throughout the year.

Our District's adopted materials for math provides numerous activities to explore graphing.

- Math Their Way Chapter 6
- Box It or Bag It (K) Part One: Seasonal Math and Chapter 11
- Math Excursions (K) Throughout the book
- Windows (K)

You may eventually want children to record on their own paper the results from a class completed graph or individual games (such as Shape Graph from Box It or Bag It) with the teacher taking dictation of student observations.

Some questions to consider:

1. Which column has the most?
2. Which column has the least?
3. Are there more _____ or _____?
4. How many more? How do you know?
5. How many fewer? How do you know?
6. How many people participated in our graph.

Key words to use with children:

- More
- How many more?
- Less
- How many less?
- Fewer
- Least
- Most
- Same, different, etc.

When using graphs with children, remember to add titles and labels.

Appendix

Mathematics Problem Solving

Student Directions

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”

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

2. PROCESSES & STRATEGIES – the “how”

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

3. VERIFICATION – the “defense”

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

4. COMMUNICATION – the “connecting path”

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

5. ACCURACY – “correctness”

- My final answer is complete, justifiable and **clearly identified.**
- 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

- 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.
- *After the students have solved a problem, have them write a new problem with a different context that can be solved the same way.
- Present the students with an unlabeled graph or table and have them write a story that represents the data on the graph or table.

*ideas from Larry Buschman, Corvallis School District

Kindergarten and First Grade

More suggestions for teaching problem solving

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.

Kindergarten Record Keeping Option

Math problems in the kindergarten problem-solving bank have only been slightly revised for 2000-2001. In most cases, kindergarten students can now work directly with manipulatives to show mastery of various expected outcomes. Since the problems in the bank are now primarily written in the form of teacher directions, areas for student scoring and mastery check-off have been eliminated from the papers on which the directions are written.

Recognizing that teachers still need a systematic way of keeping track of students' mastery of skills, individual and class record keeping forms are included in the kindergarten problem solving bank. Use of the forms is completely optional. They are intended to be used in whole or in part by teachers who may find them convenient or useful.

The forms have boxes where skills and concepts which are evaluated through the problems in the bank can be checked off. It is recognized that kindergarten students will present in a broad range of knowledge and abilities. Many blanks were deliberately left in the forms to accommodate additional information a teacher may wish to include. Therefore, a student's completed individual record may have many blank spaces while still indicating mastery of required skills and concepts.

Additionally, some of the language from kindergarten expected outcomes is used in the record keeping forms although it may not be specifically addressed in problems in the problem solving bank.

Kindergarten Problem Solving Bank
Individual Record

Name _____

Algebraic Relations

	Recognize Patterns	Create Patterns	Describe Patterns	Extend Patterns	
<i>Gingerbread Men</i>					
<i>Patterns</i>					

Calculations and Estimations

	One-to-one Correspond.	Count Objects to:	Add Object to:	
<i>Counting Objects</i>				
<i>How Many Fingers?</i>				

Geometry

	Circle		Square		Triangle			Shapes	Shapes
	Identify	Describe	Identify	Describe	Identify	Describe		Identify in environment	Sort
<i>Make a Picture</i>									
<i>Shapes Walk</i>									
<i>Sorting Shapes</i>									

Measurement

	Line up edge of units with end of object	Count units accurately		Identify		Identify
				Light	Heavy	Light, medium, heavy
<i>How Long Is Your Shoe?</i>						
<i>Heavy or Light</i>						

Probability and Statistics

	Understand Key vocabulary						
	More	Most	Less	Least	Fewer	Same	

Suggested Questions and Prompts to Help Children Build Mathematics Power

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?
- Tell (or write) a problem that uses this kind of mathematics.
- How does this relate to what we did in science (or another subject) the other day?
- How do you think a carpenter (or another worker) would use this mathematics?
- What things in your house have these shapes?
- Can you write (or draw a picture of) how you figured that out?
- Use these materials to show me how you solved the problem. Do you think that other materials would work better?

Problem Solving Strategies

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 new and inventive ways.

Use an equation or a formula - helps translate words into mathematical symbols (language).

Hints for Successful “Problem Solving”

The What...conceptual understanding

- Read and reread the problem (take notes).
- Summarize the problem in your own words: “The question asks...”
- Include the important facts.

The How...process and strategies

- Pick a strategy and devise a plan.
- Present your work in a clear and organized manner: number your steps, use models and/or symbols, cross out mistakes (don’t erase), label as much as possible.
- Identify your final solution clearly!

The Defense...verification

- Label where you checked and defended your understanding of the problem, your processes and your calculations.
- If possible, use another method for solving the problem in your defense.
- If possible, state a general rule for the problem or give another example.
- Restate solution.

The Why...communication

- Make sure that all of the parts of your work (the concepts, strategies, and verification) are connected to create a clear path, with no gaps for the reader.
- Use pictures, charts, diagrams, labels, mathematical symbols and/or words to make each step of your work clear.

The Correctness...accuracy

- Check that your final answer is complete, justifiable and clearly identified.
- Check that your answer matches the original question asked in the problem.