

WHY EARLY NUMERACY?

RATIONALE

The Rockland County Math Standards Committee created a document in 1996, which informed teachers about the math standards and the benchmark assessments at grades 4, 8, and commencement levels. Building on the work of that committee, and using the data from two administrations of the *New York State Grade 4 Math Assessment*, we have developed an *Early Numeracy Document* to provide Rockland County educators with an instructional and assessment tool in math which parallels the *Early Literacy Profile*.

This document is based on the existing countywide Vision for Mathematics. It supports learning, informs instruction, and provides a protocol to identify students who will require intervention by the end of 2nd grade. The protocol not only supports students meeting the standards by the time of the 4th grade assessment, but also meets the Academic Intervention Services (AIS) requirement of the New York State Education Department (NYSED).

Included in this document are the following:

- An Early Numeracy Operational Map/Checklist which is based on the seven Key Ideas in Math (Standard 3, MST) and provides the opportunity to assess student performance at two points in the year, Fall and Spring.
- Second Grade Tasks/Rubric includes seven tasks, one for each of the seven Key Ideas and three categories for assessing student performance and understanding on the tasks (Thorough, Partial, Not Yet). The rubric used on the *Grade 4 Math Assessment* is also included as an assessment guide for use with these three categories.
- Instructional Resources includes 4 templates for student use with classroom problems and tasks to demonstrate their use of mathematical strategies and their level of understanding of mathematical concepts. These templates support written communication in math and multiple representation of solutions. The

committee designed two of these templates. The third comes from the work of Marilyn Burns. The last template is a 4-step Process for Problem Solving (UPAC), which comes from the DMM Student Guide to Problem Solving.

- Evidence
includes guidelines for assessing student performance over time in relation to standards in math and to reasonable expectations for the grade level.
- Appendix
includes the math competencies K-4, for each of the seven Key Ideas developed by the Rockland County K-4 Math Team and an itemized list of 200 content and performance standards from The Math You Need To Know and Do (Solomon, 2000). As an alternative method of assessment the draft Second Grade Math Exit Assessment of the New Paltz C.S.D. is included. For further resources, see the Rockland County Math Standards Committee's Mathematics K-4 Teacher Information Packet (September, 1996). In addition, an excerpt from the Mathematics Resource Guide with Core Curriculum (SED, 1998), pages 3-8,; for further reference, see entire document.

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PreK – K

Key Idea 2 – Numbers and Numeration (continued)

Students use number sense and numeration to develop an understanding of the multiple uses of numbers in the real world, the use of numbers to communicate mathematically, and the use of numbers in the development of mathematical ideas

Dates of Ins
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C. Relate counting to grouping and place value

- Explore the cardinal numbers through counting of a multitude of sets and Collections of real objects, such as boys and girls, cookies, milk cartons, toy trucks, mittens, etc.

D. Recognize the order of whole numbers.

- Understand the concept of *first, next, last* and *middle*.
- Use a number line to count forward and backward, 0-20.
- Sequence numbers in their proper order.
- Understand and use the concepts *before, after, following* and *between* in classroom conversations.
- Understand such ideas as, "A whole is more than a half," and, "A half is less than a whole."

Key Idea 5 – Measurement (continued)

Students use measurement in both metric and English measure to provide a major link between the abstractions and the real world in order to describe and compare objects and data.

Dates of Ins
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C. Estimate measures such as length and volume, using both standard and nonstandard units.

- Use terms like *longer than, taller than, smaller than, shorter than, as long as*.
- Compare distances, using such terms as *farther* and *nearer*.
- Estimate in terms of *less than, bigger than, greater than, equal to, more than, the same as*.

D. Collect and display data about things that can be compared; explain data presented graphically.

- With teacher assistance, create "block graphs" and "picture graphs" to represent children's preferences.
- Gather data relating to familiar experiences by counting, tallying and using stickers, post-it notes, pictures, etc.
- Use graphs to monitor temperature over time.

E. Use statistical methods such as graphs and charts to interpret data.

- Discuss graph data in terms of *most, least, more than, less than, or the same*.
- Use the calendar to graphically organize information.
- Interpret time interval information from the calendar (*days, yesterday, tomorrow, week, month, season*).

Key Idea 6 – Uncertainty

<i>Students use ideas of uncertainty to illustrate that mathematics involves more than exactness when dealing with everyday situations.</i>	Dates of Ins
<p>PreK students will begin to and kindergarten students will be able to:</p> <p>A. Recognize situations in which only an estimate is required.</p> <ul style="list-style-type: none">• Anticipate outcomes of certain activities, such as stacking blocks until the pile falls, or how far up in the cup or bowl the water will be when ice melts, and then guessing (estimating) the results of a repeated experiment. <p>B. Develop a variety of numerical and spatial estimation skills and strategies.</p> <ul style="list-style-type: none">• Estimate sizes, using phrases like <i>about as long as</i>, <i>almost as long as</i>, <i>wider than</i>.• Predict the number of colored objects (e.g., beads, buttons, blocks) in a container and count the actual number to check the prediction.• Use string or arms to measure the circumference of trees or pumpkins. <p>C. Predict experimental probabilities.</p> <ul style="list-style-type: none">• Develop the concept of uncertainty by playing with colored spinners and dice for decision making in games and for choosing activities.• Discuss the certainty and uncertainty of events, such as whether a beanbag will land on the number 3, whether a blindfolded classmate will pick a blue block from a box, or whether a dog will fly.	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Key Idea 8 – Problem Solving

<i>Students demonstrate logical reasoning and problem solving skills through the formulation of solution strategies, implementation of solution steps, and drawing conclusions about the significance of their feelings.</i>	Dates of Ins
<p>PreK students will begin to and kindergarten students will be able to:</p> <p>A. FORMULATE Formulate a solution process, given the basic statement of a problem situation.</p> <ul style="list-style-type: none"> • Make the important decisions about the approach, materials, and strategies to use. Do <u>not</u> merely fill in a given chart, use a pre-specified manipulative, or go through a predetermined set of steps. • Use previously learned strategies, skills, knowledge, and concepts to make decisions. • Use strategies, such as using manipulatives or drawing sketches, to model problems. <p>B. IMPLEMENT Make the basic choices involved in planning and carrying out a solution.</p> <ul style="list-style-type: none"> • Make up and use a variety of strategies and approaches to solving problems, and use or learn approaches that other people use, when appropriate. • Make connections among concepts in order to solve problems. • Solve problems in ways that make sense, and explain why these ways make sense, (e.g., defend the reasoning, explain the solution.) <p>C. CONCLUDE Move beyond a particular problem by making connections, extensions, and/or generalizations.</p> <ul style="list-style-type: none"> • Explain a pattern that can be used in similar situations. • Explain how the problem is similar to other problems he or she has solved. • Explain how the mathematics used in the problem is like other concepts in mathematics. • Explain how the problem solution can be applied to other school subjects and in real-world situations. • Make the solution into a general rule that applies to other circumstances. 	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Grade 2
Key Idea 5 - Measurement

Students will be able to:

A. Understand that measurement is approximate, never exact.

- Compare weather, time and temperature in general terms.
- Recognize and explain the need for standard units of measure.

B. Select and use appropriate standard and non-standard measurement tools in measurement activities.

- Use a ruler, meterstick, and yardstick to measure to the nearest centimeter, decimeter, meter, inch, foot, and yard.
- Relate measurement of temperature to different thermometers.
- Use a spring scale to determine weight of objects.
- Use a balance scale to determine mass of objects in grams.
- Use different kinds of thermometers to measure temperature (digital, dial, mercury thermometers).
- Translate time between digital and analog clocks.
- Select and use appropriate nonstandard measurement tools.

C. Understand the attributes of area, length, capacity, volume, weight, time, temperature, and money.

- Compare capacities of containers.
- Use the kilogram and liter.
- Measure time in increments of half hours, quarter hours, minutes and seconds, using digital and analog clocks.
- Make change for amounts of money up to one dollar, using pennies, nickels, dimes, quarters, and half-dollars.
- Measure temperature and interpret findings.

D. Estimate measures such as length, perimeter, area, and capacity using both standard and nonstandard units.

- Measure objects, using nonstandard units.
- Estimate sizes, using phrases like *about as long as*, *almost as long as*, *wider than*.
- Use meter, centimeter, and decimeter for estimating length.
- Carry out conversions between *cm* and *m*.

E. Collect and display data about things that can be compared; explain data presented graphically.

- Collect data concerning measurements.
- Organize measurement data using bar graphs, pictographs, models, pictures and lists.

F. Use statistical methods such as graphs, tables, and charts to interpret data.

- Compare data in terms of number, equality, inequality, similarities, and differences.
- Understand how graphs can help one to understand observations and statistical data.

KEY IDEA 3 - Operations

<i>Students use mathematical operations and the relationships among them to understand mathematics.</i>	Dates of Ins
<p>Students will be able to:</p> <p>A. Add, subtract, multiply, and divide whole numbers.</p> <ul style="list-style-type: none"> • Add and subtract numbers less than 100,000. • Subtract with zeros in the minuend. • Multiply two-digit numbers by two-digit numbers. • Multiply by multiples of 10. • Divide three-digit dividends by one-digit divisors (quotient and remainder). <p>B. Develop strategies for selecting the appropriate computational and operational method in problem-solving situations.</p> <ul style="list-style-type: none"> • Solve real-world problems involving addition, subtraction, multiplication and division. • Use diagrams, charts and tables to help understand and organize information in problems. • Use open sentences to model problems. • Use the commutative, associative, distributive, and inverse properties. • Look for patterns. • Break problems into parts. <p>C. Know single-digit addition, subtraction, multiplication, and division facts.</p> <ul style="list-style-type: none"> • Understand the inverse relationship of operations. • Know the multiplication and division facts to 100. • Understand the identity elements of addition and multiplication in the learning and understanding of number facts. <p>D. Understand the commutative and associative properties addition and multiplication.</p>	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

KEY IDEA 5 - Measurement (continued)

<i>Students use measurement in both metric and English measure to provide a major link between the abstractions of mathematics and the real world in order to describe and compare objects and data.</i>	Dates of Ins
<p>Students will be able to:</p> <p>D. Collect and display data.</p> <ul style="list-style-type: none">• Graph statistical data from multiple sources using a bar graph and pictograph.• Make a frequency table from tallied data using single units.• Organize data using graphs, models, pictures, lists, etc. <p>E. Use statistical methods such as graphs, tables, and charts to interpret data.</p> <ul style="list-style-type: none">• Use concrete materials to discover and understand the concept of median and mode.• Find the range, median and mode in a collection of organized data.	<hr/> <hr/> <hr/> <hr/> <hr/>

KEY IDEA 6 - Uncertainty (continued)

<i>Students use ideas of uncertainty to illustrate that mathematics involves more than exactness when dealing with everyday situations.</i>	Dates of Ins
<p>Students will be able to:</p> <p>F. Predict experimental probabilities.</p> <ul style="list-style-type: none">• Conduct and predict outcomes of experiments with likely outcomes.• Recognize events that are certain to occur and events that will never occur.• Explain why a game is fair or unfair. <p>G. Make predictions, using unbiased random samples.</p> <ul style="list-style-type: none">• Begin to understand the meaning of unbiased random sample.• Conduct polls and make generalities from collected data.• Using spinners, colored blocks or die collect data to check predictions. <p>H. Determine probabilities of simple events.</p> <ul style="list-style-type: none">• Determine the number of different ways an event can occur when tossing a cube, tossing a coin, spinning a spinner, or choosing one object out of a group.• Begin to use fractional notation to express the probability of an event occurring.• Use the word <i>chance</i> when referring to the likelihood of an event occurring.	<hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Grade 2 Math Task Rubric

Thorough	Partial	Not Yet
<p>A thorough response or solution :</p> <ul style="list-style-type: none"> • Is complete and accurate • Demonstrates a thorough understanding of the mathematical concept or procedure embedded in the task • Indicates student has used mathematically sound procedures • Contains clear and concise explanations and/or shows adequate work 	<p>A partial response or solution:</p> <ul style="list-style-type: none"> • Is partially correct and may have some inaccuracies • Demonstrates a partial understanding of the mathematical concept or procedure embedded in the task • Addresses some elements of the task correctly but may be incomplete or contain some procedural or conceptual flaws • May contain correct solution but provides incomplete procedures, reasoning, or explanations <div style="text-align: center;">OR</div> • May contain an incorrect solution but applies a mathematically appropriate process 	<p>A not yet response or solution:</p> <ul style="list-style-type: none"> • Is incorrect and inaccurate • Does not demonstrate any understanding of the mathematical concept or procedure embedded in the task • Does not address any elements of the task • Does not contain a correct solution, reasoning, procedure, or explanation

EARLY NUMERACY OPERATIONAL MAP

GRADES K - 2

NAME: _____

SCHOOL: _____

Elementary Key Idea	
1. Mathematical Reasoning	Students use mathematical reasoning to analyze mathematical situations, make conjectures, gather evidence, and construct an argument.
	Students:
A.	Use models, facts, and relationships to draw conclusions about mathematics and explain their reasoning.
B.	Use patterns and relationships to analyze mathematical situations.
C.	Justify their answers and solution processes.
D.	Use logical reasoning to reach simple conclusions.
2. Number and Numeration	Students use number sense and numeration to develop an understanding of the multiple uses of numbers in the real world, the use of numbers to communicate mathematically, and the use of numbers in the development of mathematical ideas.
	Students:
A.	Use whole numbers and fractions to identify locations, quantify groups of objects, and measure distances.
B.	Use concrete materials to model numbers and number relationships for whole numbers and fractions including decimal fractions.
C.	Justify their answers and solution processes.
D.	Use logical reasoning to reach simple conclusions.
3. Operations	Students use mathematical operations and relationships among them to understand mathematics.
	Students:
A.	Add and subtract whole numbers
B.	Develop strategies for selecting the appropriate computational and operational method in problem solving.
C.	Know single-digit additional and subtraction facts and develop readiness for multiplication and division facts.
D.	Understand the commutative and associative properties.
4. Modeling/Multiple Representation	Students use mathematical modeling/multiple representation to provide a means of presenting, interpreting, communicating, and connecting mathematical information and relationships.
	Students:
A.	Use concrete materials to model spatial relationships

	B.	Construct charts and graphs to display and analyze real-world data.
	C.	Use multiple representations (manipulative materials, pictures, diagrams) as tools to explain the operation of everyday procedures
	D.	Use variables such as height, weight, and hand size to predict changes over time.
	E.	Use physical materials, pictures, and diagrams to explain mathematical ideas and processes and to demonstrate geometric concepts.
5.	Measurement	Students use measurement in both metric and English measure to provide a major link between the abstractions of mathematics and the real world in order to describe and compare objects and data.
		Students:
	A.	Understand that measurement is approximate, never exact.
	B.	Select appropriate standard and nonstandard measurement tools in measurement activities.
	C.	Understand the attributes of area, length, capacity, volume, weight, time, temperature, and money.
	D.	Estimate measures such as length, perimeter, area, and volume, using both standard and nonstandard units.
	E.	Collect and display data.
	F.	Use statistical methods such as graphs, tables, and charts to interpret data.
6.	Uncertainty	Students use ideas of uncertainty to illustrate that mathematics involves more than exactness when dealing with everyday situations.
		Students:
	A.	Make estimates to compare to actual results of both formal and informal measurement
	B.	Make estimates to compare to the actual results of computations.
	C.	Recognize situations in which only an estimate is required.
	D.	Develop a wide variety of estimation skills and strategies.
	F.	Predict experimental probabilities.
	G.	Make predictions, using unbiased random samples.
	H.	Determine probabilities of simple events
7.	Patterns/Functions	Students use patterns and functions to develop mathematical power, appreciate the true beauty of mathematics, and construct generalizations that describe patterns simply and efficiently.
		Students:
	A.	Recognize, describe, extend, and create a wide variety of patterns
	B.	Represent and describe mathematical relationships.
	C.	Explore and express relationships, using variables and open sentences.
	D.	Solve for an unknown, using manipulative materials.
	E.	Use a variety of manipulative materials and technologies to explore patterns.
	F.	Interpret graphs.
	G.	Explore and develop relationships among two-and three-dimensional geometric shapes.
	H.	Discover patterns in nature, art, music and literature.

Name _____

Teacher _____

Date _____

Grade _____

Operations

- Using the digits 3, 4, and 5, place each digit in a box to get the largest possible answer (sum). No digit may be used more than once.

$$\begin{array}{r} \boxed{5} \quad \boxed{} \\ + \quad \boxed{} \\ \hline \end{array}$$

- Can you get this sum another way?

$$\begin{array}{r} \boxed{} \quad \boxed{} \\ + \quad \boxed{} \\ \hline \end{array}$$

Explain your answer in words in the box below.

Name _____

Teacher _____

Date _____

Grade _____

Modeling/Multiple Representation

Take a bag of multi-colored unifix cubes. Sort the cubes by color. Show your sort in the box below.

SORT:

Make a chart showing how you sorted your cubes. Show how many cubes are in each group.

CHART:

Construct a bar graph using the data you collected.

GRAPH:

Write one or two sentences that tell what you learned from the data.

Name _____

Teacher _____

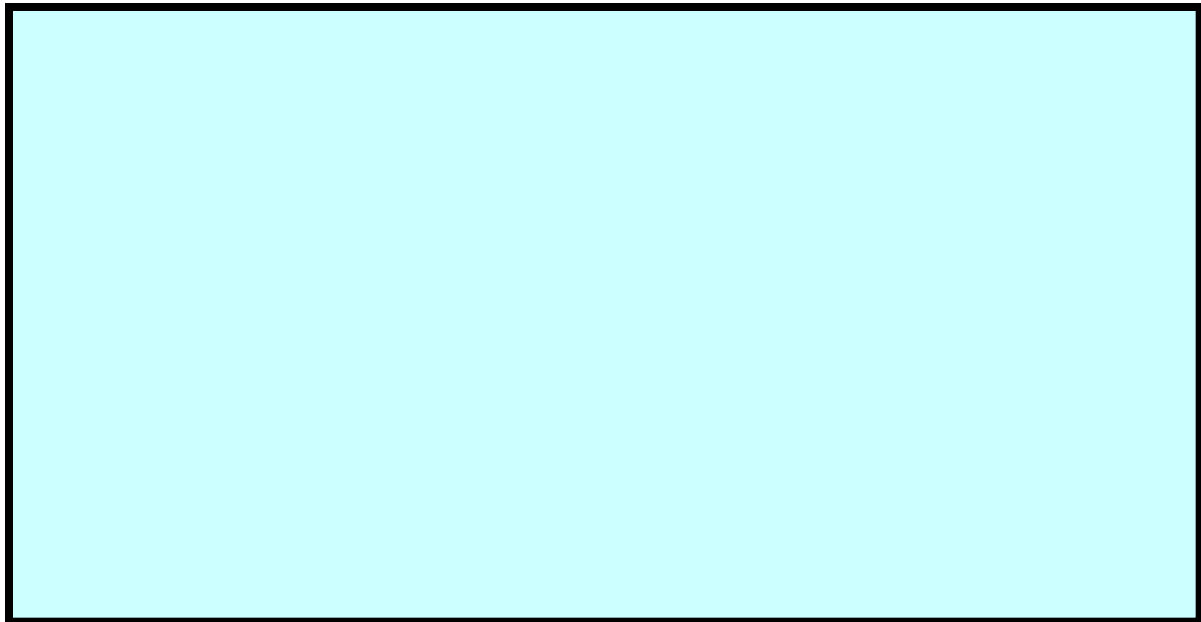
Date _____

Grade _____

Measurement

- Hasim has 24 pennies in his piggy bank. His grandma offers to give him 3 dimes when he has thirty pennies.
- How many more pennies will he need in order to get 3 dimes from his grandma in exchange?
- How many dimes could he get in exchange for his 24 pennies now?

Show your work in the box below:

A large, empty rectangular box with a black border, intended for showing work. The box is filled with a light blue color.

Name _____

Teacher _____

Date _____

Grade _____

Uncertainty

"I Hope I Pick A Red One"

Sam's teacher put 2 red candies and 4 green candies in a bag without looking. She asked Sam to pick one candy out of the bag without looking. If Sam reaches into the bag without peeking, what color candy is he more likely to pick?

Red Candies



Green Candies



- What could be done by the teacher to give Sam an equal chance of getting a red candy?

Explain in words and show your work below.

Name _____

Teacher _____

Date _____

Grade _____

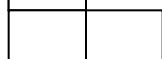
Patterns/Functions

- Robbie goes up the stairs in his house 2 at a time. If he goes up the stairs (2, 4, 6,) as shown below, then

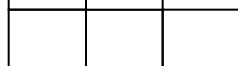
Row 1



Row 2



Row 3



Row 4

- Add another row to the bottom to continue the pattern by drawing row 4.
- How many square counters would be in row 5?

Name _____

Teacher _____

Date _____

Grade _____

Mathematical Reasoning

There are 4 cows and 3 chickens on a farm.
How many feet and tails are there
altogether?

Show your work below.

Name _____

Teacher _____

Date _____

Grade _____

Number and Numeration

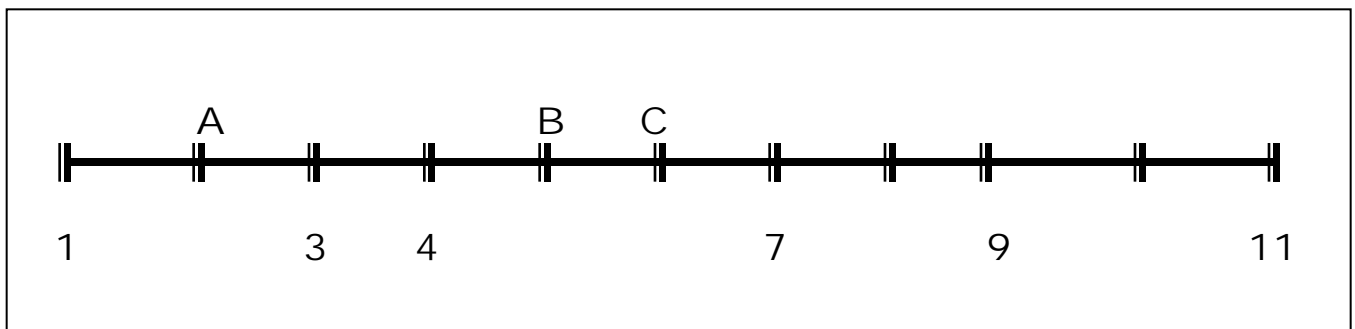
Look at the number line below.

Which letter stands for:

More than 1 and less than 3? _____

2 more than 3? _____

1 less than 7? _____



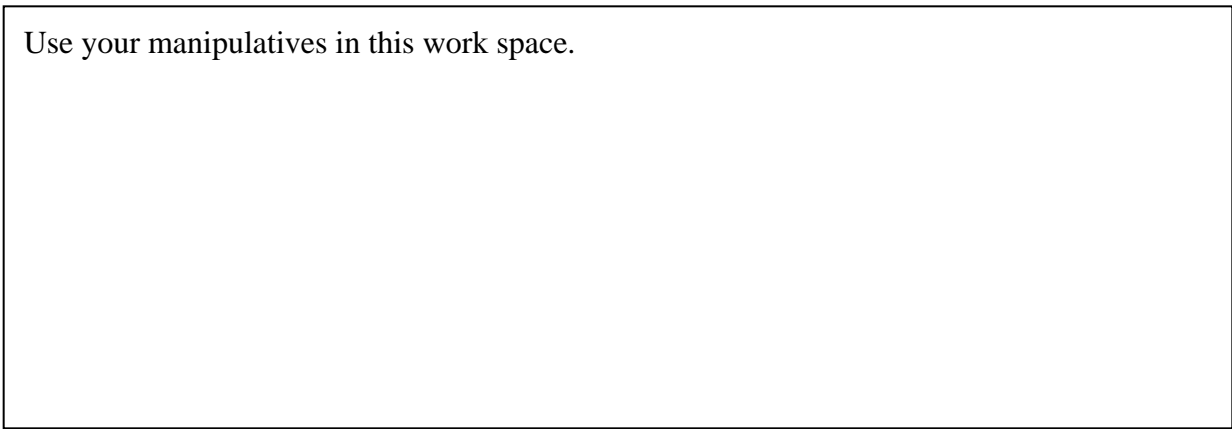
Name _____ Teacher _____

Date _____ Grade _____

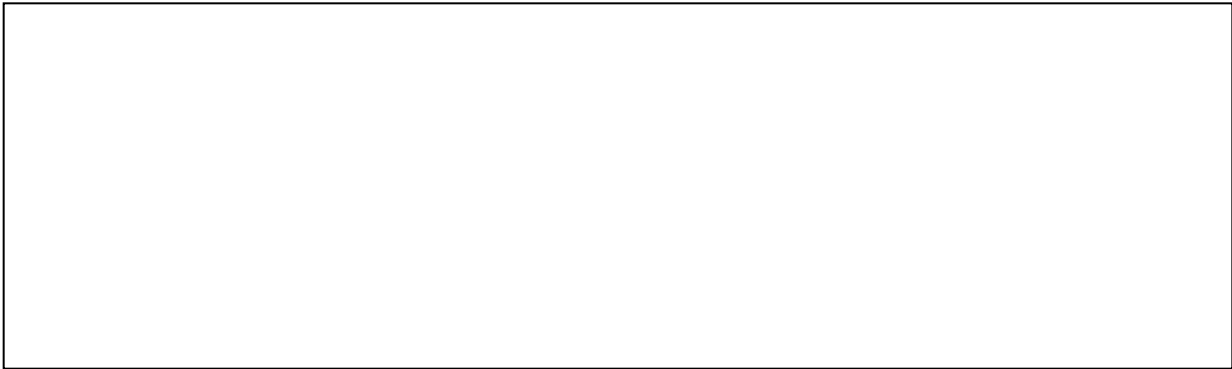
Show Your Work: Template #1

DO:

Use your manipulatives in this work space.



SHOW:



EXPLAIN IN WORDS:

Name _____ Teacher _____

Date _____ Grade _____

Show Your Work: Template #2

<p>Concrete Example (Use real objects to solve the problem in this space.)</p>	<p>Pictorial Representation (Make a picture of the problem or trace the objects in this space.)</p>
	<p>Abstract Representation (Show the algorithm or formula for the problem.)</p>

Adapted from: DMM Student Guide to Problem-Solving, Ed Tech.

Template #3: Writing in Math Class, by Marilyn Burns (1995).

“Incorporating writing into math class adds an important and valuable dimension to learning by doing. Writing encourages students to examine their ideas and reflect on what they have learned. It helps them deepen and extend their understanding. When students write about mathematics, they are actively involved in thinking and learning about mathematics.”

“Writing not only benefits children by contributing to their learning, it benefits teachers by helping them access what their students are learning. Students’ writing also provides insights into how they think and reason mathematically. A broader awareness of what they understand as well as what they are able to do. Assessing is best done in the context of classroom learning and when integrated into the instructional program. Students’ writing is particularly beneficial for assessment, however, as it provides concrete way to review and revisit their thinking and reflect on what they are learning.”

1: STATE THE PROBLEM OR CONCEPT

5. Answer: _____
Correct solution

4. Algorithm or number sentence

3. A graphic representation of how you solved the problem:

- Pictorial
- Chart, table, graph
- Manipulatives
- Diagram

2. Metacognitive Journal
Explain, in words, how you solved the problem:

- A step-by-step procedure of the solution
- Use appropriate mathematical language
- Identify obstacles or what may be unclear in own thinking
- Demonstrate, using words, your understanding of a skill, concept or process

Template #4
UPAC – The 4-STEP PROCESS for Problem Solving

UNDERSTAND	Understand the problem	What do you need to find out: Can you state the problem in your own words? What kind of answer will solve the problem? Is it...a count?...a measure?...an estimate? a drawing?...a list?...a chart?...a shape? ...a path?...a map?
	Identify the data	What do you know? What data does the problem give you? What do you need to know to solve the problem? Do you have enough information? If not, where can you find it?
PLAN	Make a plan for solving the problem	What are you going to do?
	Select a strategy	Could you...use manipulatives?...measure? ...sort or ...classify objects? Could you ...draw a picture?...make a tally? ...make a chart?...make a graph?...make a list? Could you...look for a pattern?...work backwards? ...find similarities or differences? ...solve a simpler problem into smaller parts? ...break the problem into smaller parts? ...guess an check?...use smaller numbers? ...compute? If you compute, what operation will you use? Do you need more than one operation? Will you use...a calculator?...mental math?...paper and pencil? Estimate a solution? What do you think you will get?
ANSWER	Carry out the plan	What is your solution to the problem?
	Get an answer	If your answer is a number, what label or unit does it have?
CHECK	Check to see whether the Answer solves the Problem	How does your answer solve the problem? Does it make sense? Is it reasonable? If not, return to PLAN and rethink another possible strategy. Did you get the kind of answer you expected? If you made and estimate, is your answer close to your estimate? If not, check your counting or computation
PROCESS	Use alternative strategies	Is there alternative ways to solve the problem; or represent the solution.

UPAC RUBRIC

UNDERSTANDING THE PROBLEM	2: Complete understanding of the problem 1: Part of the problem misunderstood or misinterpreted 0: Complete misunderstanding of the problem
PLANNING THE SOLUTION	2: Appropriate plan if implemented properly 1: Partial correct plan based on part of the problem being interpreted correctly 0: No attempt or inappropriate plan
GETTING AN ANSWER	2: Correct answer and appropriate label 1: Partial answer for the problem, perhaps making an error in computation 0: No answer or wrong answer
CHECKING THE RESULTS	2: Complete explanation of how and why the result is appropriate 1: Attempt was made to justify or verify 0: No evidence of review or verification
PROCESS	2: An alternative solution or multiple representation is thoroughly presented 1: A partial alternative solution or multiple representation is presented 0: No evidence of an alternative solution or multiple representation is presented

EVIDENCE:

The Early Numeracy Portfolio Assessment:

- Supports learning
- Informs instruction
- Can be used for accountability purposes

The Portfolio:

- Demonstrates students progress over time
- Identifies students who require intervention or support to meet standards by the time of the 4th grade math assessment
- Provides information about performance trends and grade Level contributions in relation to MST Standards.

Assessment is on going and should be embedded into instructional activities. The “evidence” should emphasize what children know and can do. The portfolio should contain multiple forms of evidence.

- Criterion – reference tests and quizzes, which are teacher made;
- Observational checklists (i.e. East Ramapo) – the “taught curriculum.”
- Performance task assessment (s) at least one for each key idea, in fall and spring. Exemplars, using the prescribed rubric.
- Student writing journals – templates, UPAC, Marilyn Burns, “Problem of the Day”.
- 2nd Grade extended tasks.